

# POPULAR SCIENCE

MONTHLY

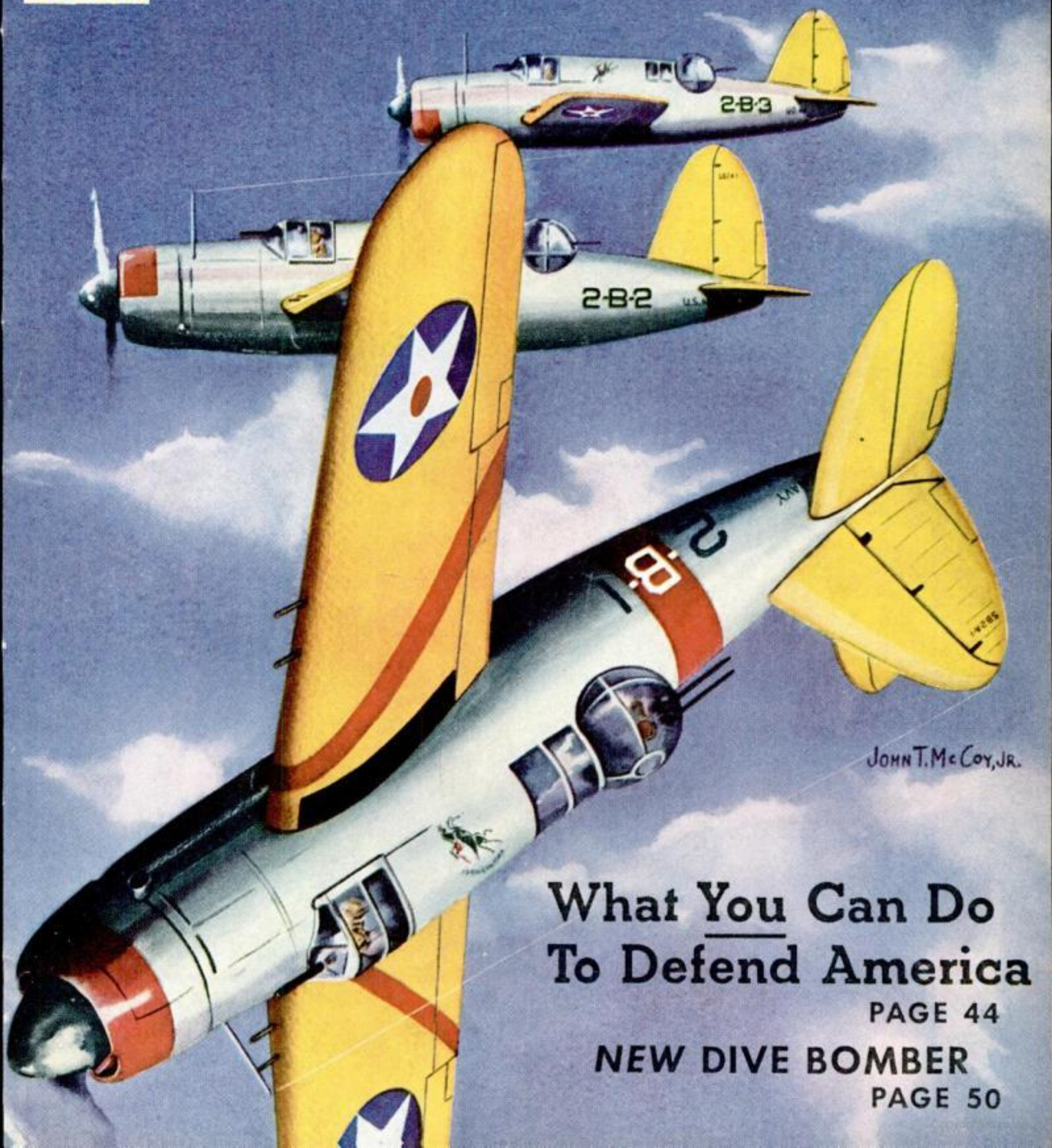
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PAGE 50





**"THE TORPEDO STRUCK US  
WITH THE ROAR OF DOOM!"**



A true experience of Frank C. Davidson, Truro, Nova Scotia, Stoker First Class on the torpedoed H. M. S. Rajputana.

**1** "HAD WE EXPECTED a second torpedo to strike the wounded British Cruiser, *Rajputana*, two of the boys and I would never have scrambled below to save a few of our belongings.

**2** "BUT THERE WE WERE, in the stokers' mess, when torpedo number two ripped into us with a terrific explosion. Instantly, we were in utter darkness . . . trapped by tables, chairs, and lockers crashing about us. Escape seemed impossible . . . until I remembered my flashlight.



**3** "WITH THE AID of that light, we managed to fight our way, dazed and confused, to the boat deck, just as the captain gave the order to abandon ship. I shall never forget what might have happened out there on the Atlantic had it not been for my flashlight and 'Eveready' fresh DATED batteries.

(Signed)

*Frank C. Davidson*



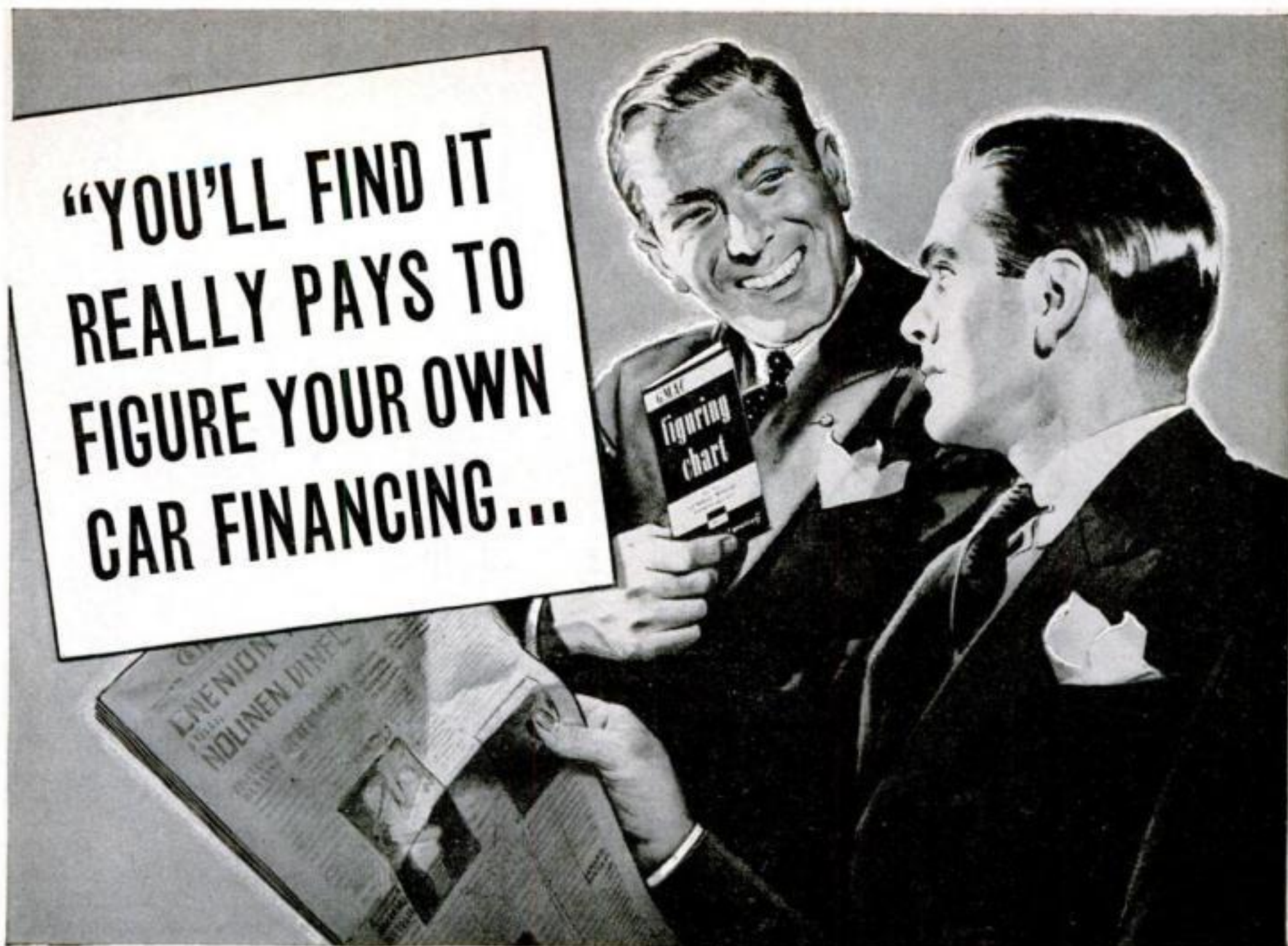
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# POPULAR SCIENCE

FOUNDED 1872

MONTHLY

VOL 139 NO. 3

Mechanics & Handicraft

THE NEWS PICTURE MAGAZINE OF SCIENCE AND INDUSTRY

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JUAN OLIVER, New York sculptor and industrial designer, who creates ultramodern craftwork novelties for our Home and Workshop Department, began developing his unique blend of art and humor as a newspaper cartoonist in his native Chile. He collects stones, laboratory glassware, and knives; is an enthusiastic amateur photographer; likes to sail his two small boats, even in gales.

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*"What's wrong, Cowboy  
...car go lame?"*

**COWBOY:** *This thing's worse'n a half-broke bronc.*


**GIRL:** *Too bad you don't know rubber like you know saddle leather.*

**COWBOY:** *Meanin' what?*

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STEEL-VENT PISTON RINGS

*Stop Oil-Pumping*

IN CARS, TRUCKS AND TRACTORS

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## *“My business is not as usual”*

MY BUSINESS is not as usual—not by a long sight.

I don't usually have 600 or more new Army and Navy and defense plants to equip completely and quickly.

And I don't usually have the rush of business that comes when every one else is working on defense.

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When a country goes all out to produce, it uses plenty of telephone service. We are all out for defense too—doing our best to keep ahead of the job.

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At Indianapolis 500 Mile Race



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*You're always ahead with Champion!*  
SPARK PLUGS

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### Model Builders Attention!

	V	V-2	V-3
Hex	1/2"	3/8"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
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BY SOCONY-VACUUM

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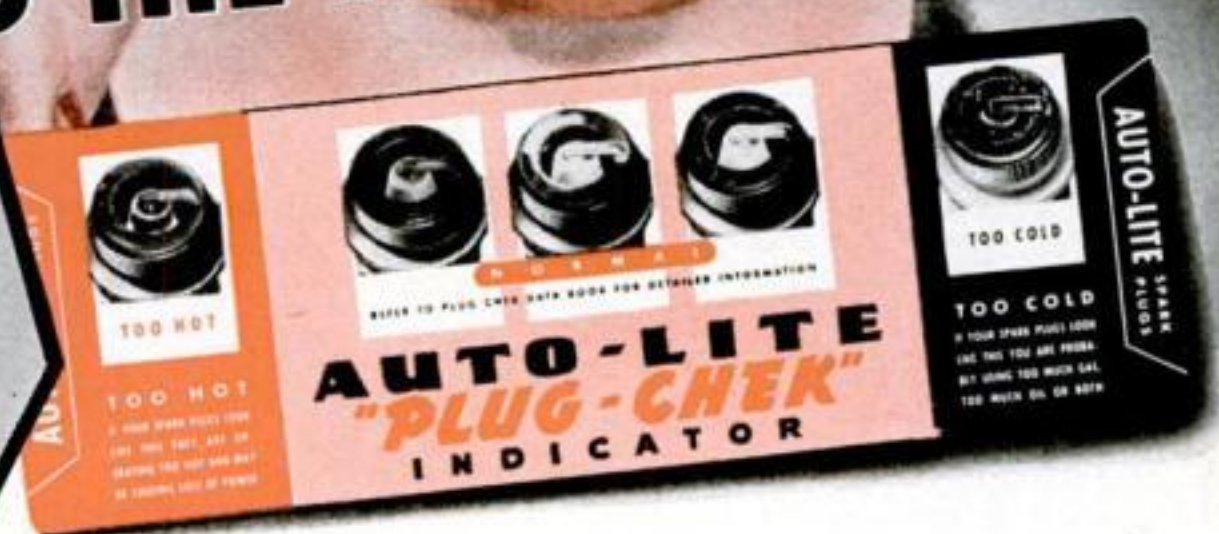
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# REVEALS THE INSIDE STORY!

New "PLUG-CHEK" Service  
Checks Spark Plug  
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- 1 CORRECT HEAT RANGE
- 2 PROPER INSTALLATION
- 3 EFFICIENT OPERATION
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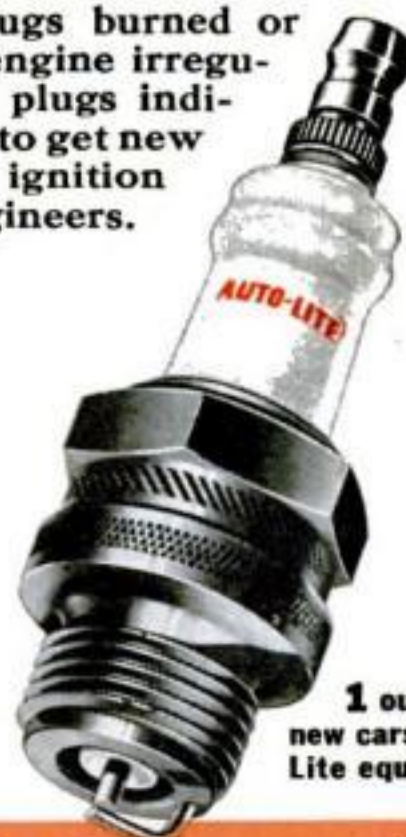
plugs not up to par—plugs burned or fouled because of some engine irregularity. And when worn plugs indicate replacement, be sure to get new Auto-Lite Spark Plugs ignition engineered by ignition engineers.



Matching the business end of your spark plugs against examples on the "PLUG-CHEK" Indicator, helps give Auto-Lite Service Men the "inside story" of your engine. Get a "PLUG-CHEK" today.



From countless tests and experiments, which were conducted on Spark Plugs under actual operating conditions, Auto-Lite engineers developed "PLUG-CHEK"—a new service for motorists.



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## The Unpublished Facts of Life

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### THIS FREE BOOK

The Rosicrucians (not a religious organization), an age-old brotherhood of learning, have preserved this secret wisdom in their archives for centuries. *They now invite you to share the practical helpfulness of their teachings*. Write today for a free copy of the book, "The Secret Heritage." Within its pages may lie a new life of opportunity for you. Address Scribe G.V.H.

**The ROSICRUCIANS**  
(AMORC), SAN JOSE, CALIFORNIA, U. S. A.

## Coming Next Month—

"PRIORITIES" is a big word in the news today. But within a few weeks it will be more than a word, when familiar household articles begin appearing with unfamiliar materials in their make-up. How defense needs for certain metals will affect your daily life is told in an article that will help to prepare you for the changes ahead.

MINES play a big part in the war at sea. Rear Admiral Yates Stirling, Jr., U.S.N., Retired, tells you all that you want to know about mines—the different types, how they are laid at sea, how mine sweepers clear the ocean lanes for warships and commercial vessels. Photographs and drawings show all the details of this dramatic phase of naval war.

EVERYBODY'S IDEAL HOME is the net result of boiling down the specifications in 3,307 house plans submitted in the Popular Science \$1,000 house-planning contest. Analyzing the entries, Greville Rickard, our architectural consultant, has arrived at a pretty definite idea of what the average man and woman want when they set out to build a home. In addition to Mr. Rickard's analysis, there will be a complete description of the first-prize house, a personality sketch of the winner, and an interesting account of the way the judges went about their big job of finding the best among so many good plans.

CALL IT A JEEP, a blitz buggy, or anything else you will, the "bantam" car is the most versatile vehicle our mechanized Army has today. To show our readers what makes it perform its astounding tricks, we got the Army to let us literally take one of them apart. After reading this description of the panzer pram, you'll know it as well as the men who ride in it—but you won't have the bruises.

MACHINISTS are in the front line of the defense program. To help beginners in this vital line of work, C. W. Woodson presents four practice projects in shopwork. Whether you're interested in it as a hobby or as a job, you'll find these projects ideal for learning fundamental processes—and you'll wind up with something useful to show for your pains. The products are a plumb bob, toolmaker's clamps, cap wrench, and sleeve-hammer center punch.

FIGHTING IN THE DARK is now an important part of military aviation. How do bombers find their targets in the night? How do fighter planes find the bombers? An article describes the new technique of war in the air, and the tricks the pilots have to learn.





**IF** you're that man, here's something that will interest you.

Not a magic formula—not a get-rich-quick scheme—but something more substantial, more practical.

Of course, you need something more than just the desire to be an accountant. You've got to pay the price—be willing to study earnestly, thoroughly.

Still, wouldn't it be worth your while to sacrifice some of your leisure in favor of interesting home study—over a comparatively brief period in your life? Always provided that the rewards were good—a salary of \$2,000 to \$10,000?

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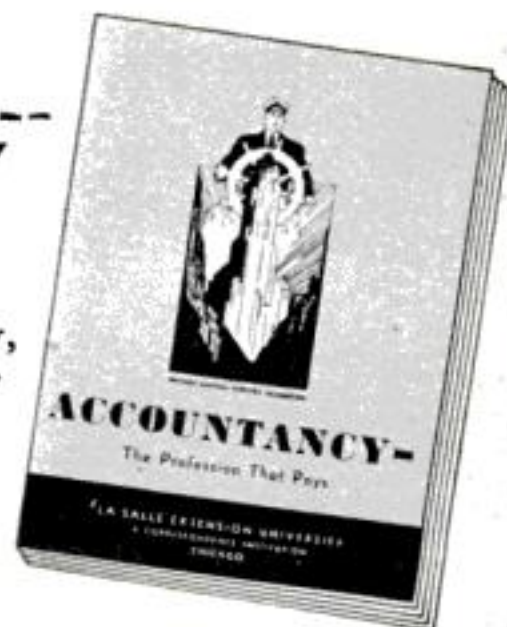
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From the  
News Editor's  
Desk

**F**RENCH ENDIVES, Italian tomato paste, Balkan paprika, and many other hitherto foreign products of the soil have already been transplanted successfully to the United States. Florida has also produced Greek sage, Dutch and Danish spinach seed, Japanese mustard and turnip seed, and French teasel burrs, highly prized for combing wool in American mills. California, not to be left behind, is raising Spanish cork and Mexican guayule rubber trees.

**D**EATH RAYS, produced by infra-red rays from a special incandescent lamp, killed cockroaches in four minutes at a distance of 18 inches, in a University of California laboratory experiment. Scientists reporting the feat cautioned, however, that the technique is scarcely applicable in household and restaurant kitchens. Infra-red apparatus might cost more than the afflicted home or business. The same rays worked equally well on many plant pests, but not before the plants themselves were seriously injured or killed.

**B**ITS OF GLASS in tires and roadways used to mean trouble. Before long, however, glass may be used to give tires greater strength with less thickness, and British engineers have already used glass to reënforce concrete in bridges. Sustained speeds of 70 and 75 miles per hour on the new superhighways destroy heavy-treaded tires; a lighter thin tire seems to be required, and glass may be just the element to give the necessary increased strength. The British have turned to glass to reënforce highway spans because of the shortage of steel.

**W**ORLD WAR I saw Germany overcome the shortage of Chilean nitrates by fixation of nitrogen from the air, when atmospheric nitrogen was turned into synthetic nitrates for explosives and fertilizers. World War II has brought the further startling development of feeding synthetic nitrogen compounds directly to livestock, instead of going through the roundabout "natural" process of fertilizing the soil, turning the nitrogen compounds into plant proteins, and then feeding the plant proteins to animals. British and Scottish experiments, as reported in the British magazine "Nature," also tend to confirm the success of the German effort. The most successful of the synthetics is said to be carbamide. Tests show that carbamide is assimilated through the action of microorganisms living in the animals' digestive tracts.

**T**HE TRAILER, an American phenomenon, is here to stay. So concludes Professor Donald Cowgill, of Drury College, in a new study revealing the existence of 1,975 "trailer cities" in the United States. Professor Cowgill estimates that trailer inhabitants will never number more than 15 percent of the total population, and that they will continue to be stable, responsible citizens.



## Readers Say:

### Battleship Drops Anchor in Secretary's Office

JUST to show how you never know where you're going in the Navy, we had the U.S.S. *North Carolina* heading due East on page 86 of the August issue of P.S.M., but here just a few weeks later she is turned around and streaking West. Anyway, Secretary Knox looks pleased, and I was sure proud to present him with this westward-bound job.—Matt Murphey, U.S.N.

*It seems there was an Irishman named Murphey and he did a painting of the U.S.S. North Carolina for POPULAR SCIENCE MONTHLY. It looked so good that he made another which was presented to the Secretary of the Navy. The photograph shows Artist Murphey and Secretary Knox.—Ed.*



### Wanted: a Tractor That Will Plow Ozarks Soil

HOW ABOUT DYNAMITE?



how.—E. W., Clarksville, Ark.

HERE in this section of the Ozarks, we need a two-wheel garden tractor (high wheels) that *will* plow—not just cultivate. Ordinary tractors will not plow this soil, but will cultivate it after it is plowed. Try in your Readers Say and see if someone has licked this same problem and is willing to tell others

### Now the Tortoise Pumps a Bike and Achilles Drives a Car

HERE'S a problem that has been confounding philosophers for 2,400 years. Disprove it: If a man in an automobile gives a boy on a bicycle a head start he will never overtake him, if the boy keeps moving, no matter how fast he goes. Say the cyclist has a 100-yard start and goes only half as fast as the motorist. When the motorist has traveled the 100 yards, the cyclist will be 50 yards ahead and when the motorist has traveled that 50 yards the cyclist will be ahead 25 yards—then  $12\frac{1}{2}$  yards,  $6\frac{1}{4}$  yards,  $3\frac{1}{8}$  yards, and so on. Since half a positive number is always a positive number, the motorist will never overtake him!—J. D. G., Wallace, Idaho.

### A Scaffold Worker Pleads for Kinkproof New Rope

CAN YOU spare a little space to broadcast an SOS for an urgently needed improvement in Manila hemp rope? Anyone who, like myself, works on hanging or swinging scaffolds will attest that one of the greatest nuisances we must struggle with is new rope. It is notoriously unmanageable until it is "broken in." It's almost as stiff as steel cable, and it twists into kinks that are a helluva job to remove. Kinky rope can cost a man his life when he's struggling with it with one hand and holding his scaffold with the other, ten stories up. Why don't rope manufacturers find out why new rope behaves so badly, and then try to eliminate the trouble? Just what is it that happens to rope during the "breaking-in" period that eventually renders it easy to handle? Is it repeated flexing, wetting and drying, sun's heat, stretching, packing closer together of the fibers, dust and dirt, loosening of the strands? *What* is it? And whatever it is, why can't it be taken care of mechanically during or immediately after manufacture so the buyer would get a rope which has already been broken in? Won't somebody who can please do something about this? Thanks!—A. V., New York, N. Y.





# Readers Say:

## He'd Have a Fluid Drive on the Starter, at Least

NOISELESS HORNS ARE MORE TO THE POINT!



WHILE looking over With the Inventors columns, I thought of an idea. Why not have a fluid-drive starter for these new cars? Every time someone starts a new car, he holds the starter button down after the motor is running, and it makes a whirring noise. With a fluid-drive hook-up there would be no

noise.—R. O. F., Aberdeen, S. D.

## When the Sole Is Lost, Can You Save the Upper?

How can the leather tops of old shoes be used advantageously?

It seems a shame that so much leather goes to waste when the soles are gone and the sides pull out. New shoes can be bought cheaper than old ones can be mended. I surely wish someone would find a use for old leather, while they are doing so much with chemicals. —Mrs. E. J. H., Salt Lake City, Utah.

OH DEAR, THERE'S ALWAYS SOMETHING TO WORRY ABOUT!



## Cheese Boxes Again: This Time It's a Filing Case for Slides

You got plenty of suggestions about using those empty cheese boxes, but I'm surprised that no amateur photographer told about making them into slide filing boxes. You take some corrugated paper of the kind used in packing, cut it to the width of the box sides, and glue it on the inside of the longest dimension. With a two-pound cheese box, this makes a 35-mm. filing box that the two-by-two slide will just fit.—Dr. P. B. G., Peoria, Ill.

## What Made the Kitten Britches Burn on the Wrong Side?

FIGURE IT OUT FOR YOURSELF, YE-E-OH!



ONE cold winter day, a cat was sitting against a stove at our school. The stove became very warm and I smelled something burning. The cat's fur was scorching. After careful examination by the teacher, it was found that the cat was not burning on the side touching the stove, but on the opposite side. Let some scientist try

and figure that out.—Miss E. A., Morrisonville, Ill.

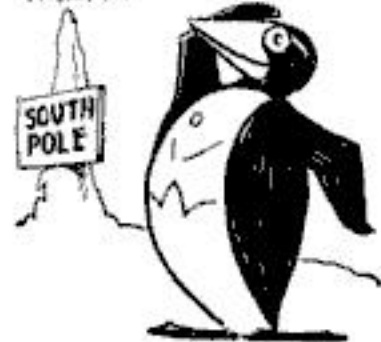
## Movie Operator's Night Off Is a Busman's Holiday

DID you ever wonder what we movie operators (projectionists) do for pastime while running the same film a half dozen times in succession? I, for one, take out my specs and look for technical errors in the movie. One of my pet errors was one I saw in "The Return of Frank James." Remember in the closing scenes when Frank James had the villain in the second floor of the livery stable? Four shots were fired through a door by John Carradine. He fired the first two, the scene shifted to the door, and behold there were four holes in it! Then he fired two more shots, but no more holes appeared. The film editor must have slipped, or the villain was using a new type of firearm. One more thing: do you know what we projectionists do when we have a night off? Why, we drop in at a theater to see a movie! —J. A. W., Holdingford, Minn.

## Another Candidate for the Penny-Balloon Record

ANSWERING J. A. F.'s letter about his penny-balloon flight: With another boy, I filled some penny balloons with hydrogen and let them go on a Sunday in a strong south wind. We heard no answer for two weeks. Then I received a letter from a breakwater tender on Hudson Bay. As near as I can figure, the balloon went about 1,200 miles.—R. W. C., Royal Oak, Mich.

WAIT'LL ONE COMES DOWN HERE, THEN TALK!





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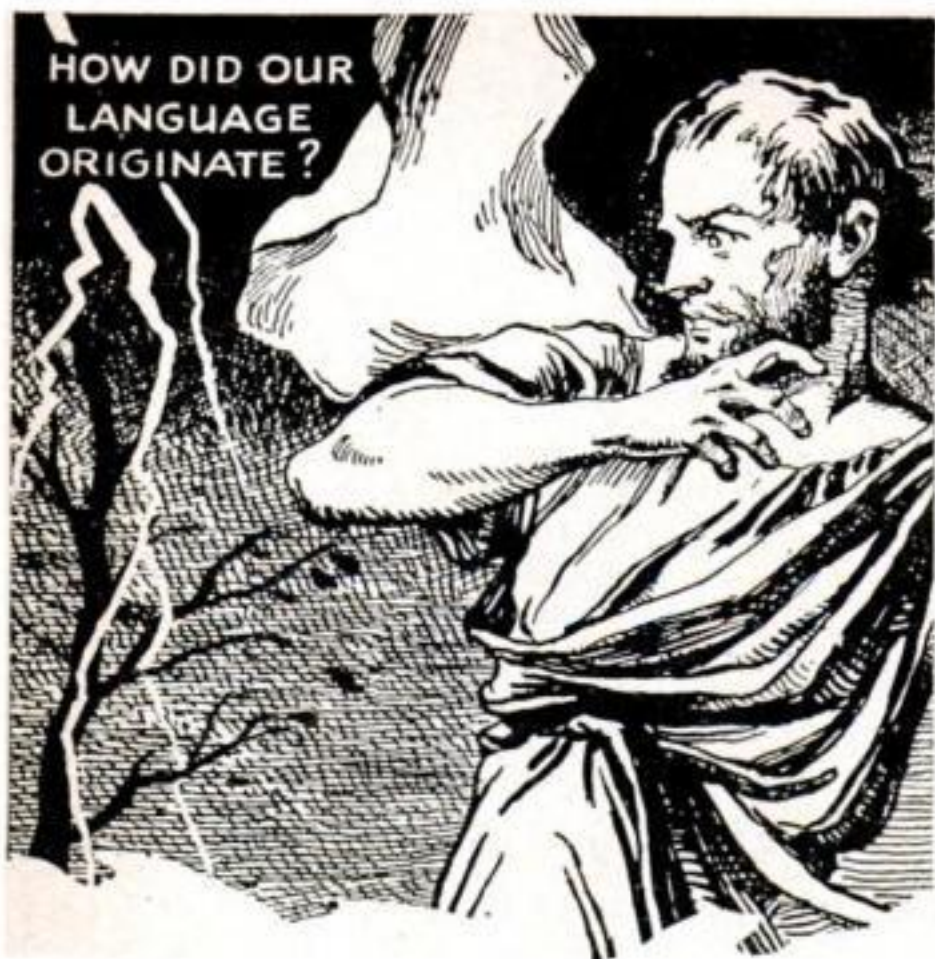
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# Astonished

actually means thunderstruck

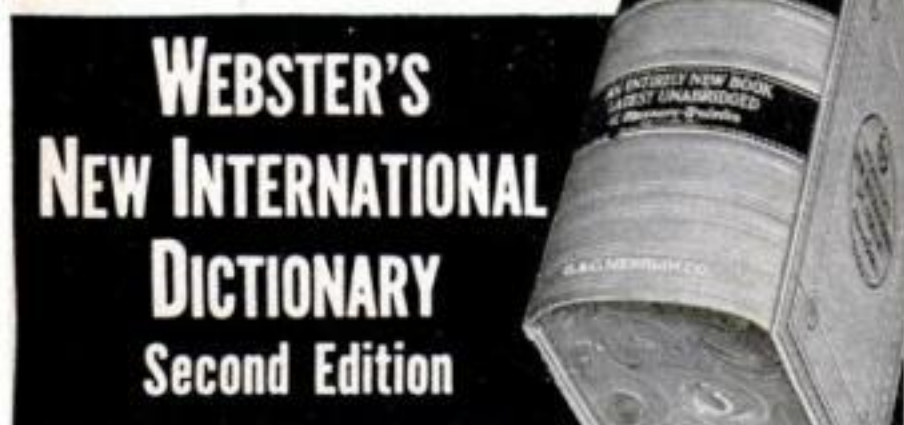
WHEN we trace our English word *astonish* back through the Middle English *astonien* and Old French *estoner*, we find its original source in Latin *ex*, "out," combined with *tonare*, "to thunder." The first meaning of *astonish* was "to stun," "to render senseless," as by a thunderbolt or a blow. But the word has lost its physical significance and now suggests great surprise, sudden fear, or wonder.

To *tantalize* is to torment with the punishment of Tantalus as told in Greek mythology. *Disaster* literally means "the stars are against you."

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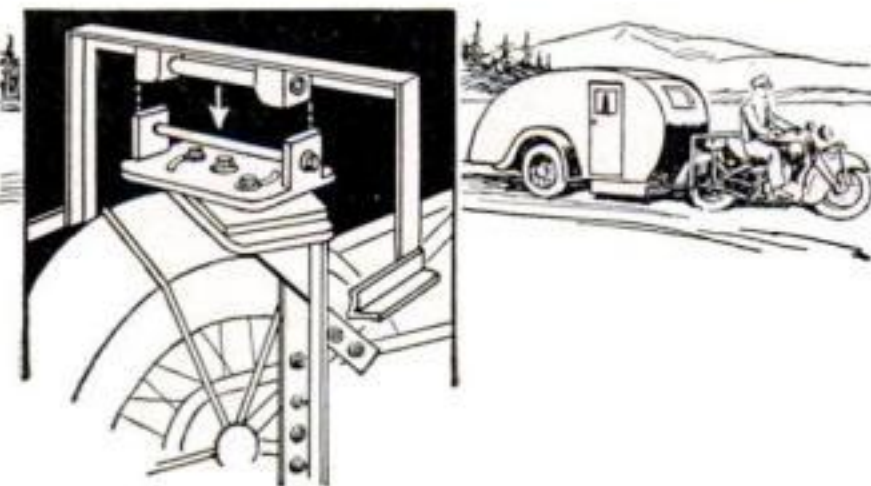
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the Genuine Webster



## With the Inventors

A SAFE and sturdy trailer hitch for motorcycles, patented by Vincent Rea of Brooklyn, N. Y., has served its inventor successfully in trips from Maine to Florida, and at speeds up to 75 miles an hour. No alteration of the motorcycle frame



is needed to attach, with U bolts, heavy members that support a bed plate behind the saddle. A second plate swivels upon the first, between limits imposed by curved slots engaging a pair of bolts. To attach the trailer, a long horizontal bolt is removed while an extension of the trailer chassis, terminating in a tubular bearing, is dropped into place. The bolt is then replaced and its nut locked on, the whole operation requiring only a minute's time. Upon arrival at the desired camp site, the trailer may be detached as quickly, and propped up with a log to serve as a cabin with complete living accommodations for two persons. . . . MASH-ER AND FLUFFER are combined in a handy kitchen tool for making mashed potatoes,



designed by Selma Anderson of Tacoma, Wash. The bottom part, which serves as a masher, is used in the usual way. Meanwhile a crank is turned, as on an egg-beater, and rotating arms complete the mashing and fluffing. Since both operations are performed at once, instead of in separate steps, the utensil serves as a time-saver for the busy housewife. . . . AN AUTO-

GIRO WITH ONE WING now joins the strange family of "windmill planes." A counterweight balances the other side of the rotating appendage. Invented by the late

(Continued on page 18)



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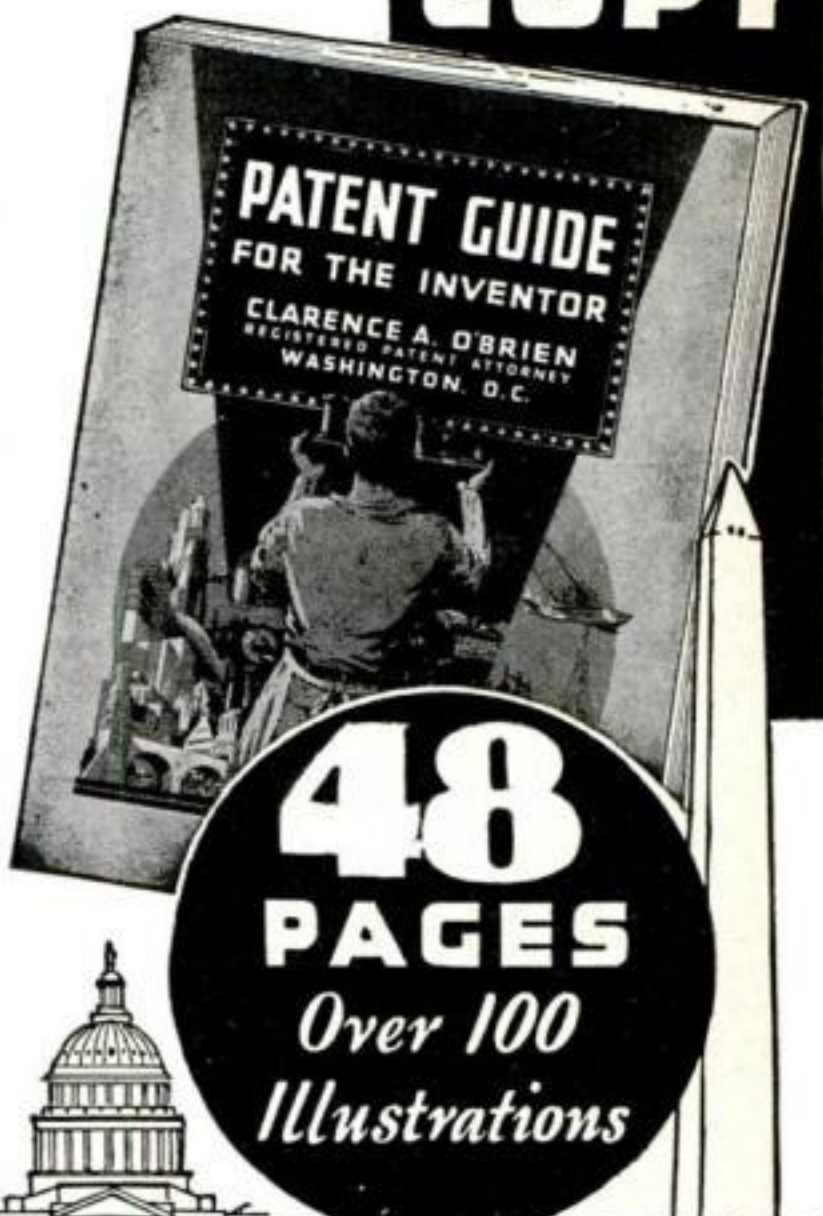
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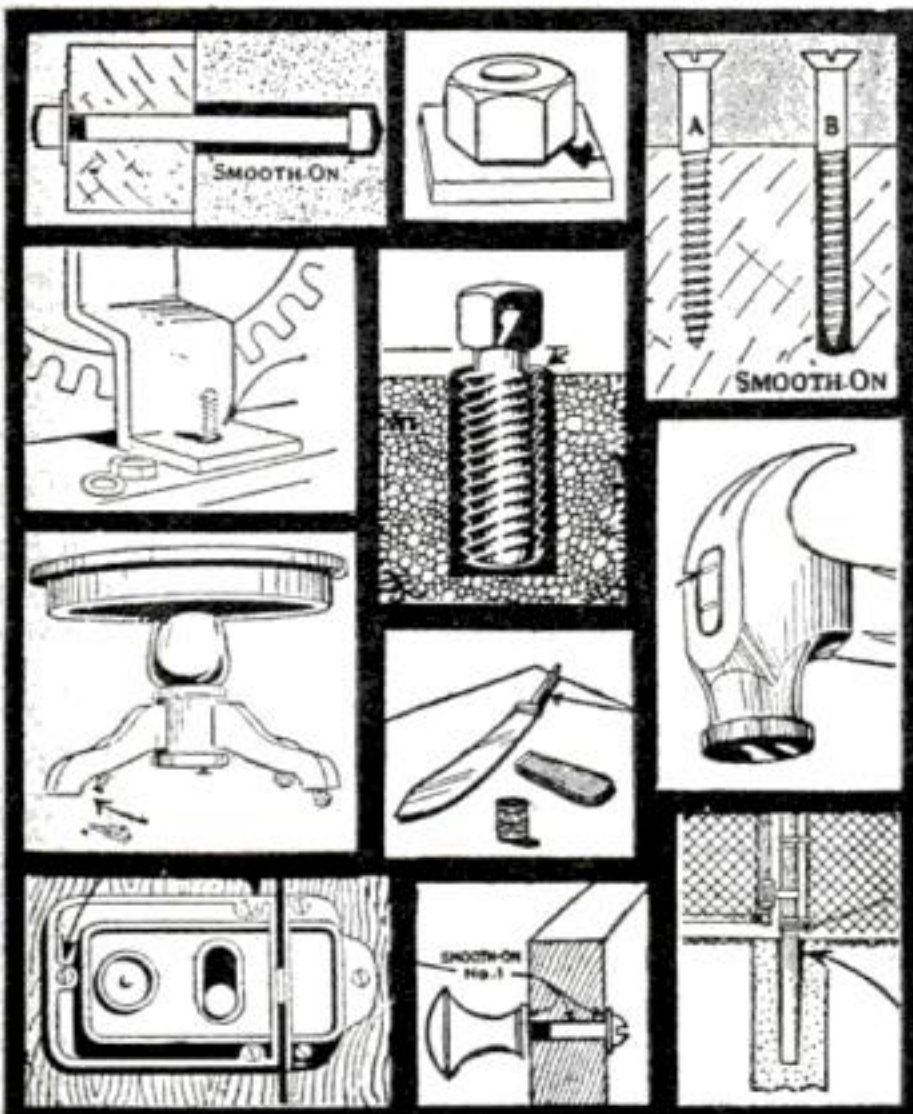
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## With the Inventors

(Continued from page 16)

Juan de la Cierva, autogiro pioneer, the odd craft avoids the disadvantage of vibration observed at times in multibladed machines. With its single vane pointed rearward, it can also be parked in a minimum of space. . . . GRIPPED BETWEEN THE TEETH, a flashlight leaves both hands free, when fitted with an attachment devised by Frank L. Colby of Forest City, Iowa, for use by garage mechanics and others. His device consists of a T-shaped rubber bit held in the mouth, together with a rubber support that rests against the chin. Lined with metal, which is threaded at the rim, the invention fits any



conventional flashlight, replacing the regular base cap. A hole in the chin brace offers a handy means to hang up the light when it is not in use, as shown in the accompanying close-up sketch. . . . A MAGNETIC PAINTING SET, developed by Raymond G. Osborne of Los Angeles, Calif., employs powdered iron and ores, attractively painted or dyed, for colors. Because of their difference in magnetic susceptibility, each pigment may be selectively moved about a board by an ordinary horseshoe magnet capped with a plastic spacer of the proper thickness. It may also be removed with the magnet and put back in its container, which, like the



spacer, bears the same hue for identification. Thus the paints may be economically used over and over again. Moreover, the inventor declares, the fascination of picking up the colors with the magnet "makes it a pleasure, for the first time, for a child to put things

(Continued on page 20)



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## With the Inventors

*(Continued from page 18)*

back where they belong." . . . A CONVENIENT SHOULDER SUPPORT for a hand-set telephone, invented by Alvin N. Epstein of Chicago, Ill., permits use of both hands for taking notes or referring to correspondence during



a call. Only the gentle pressure of the user's ear is required to hold the phone in place. Three pairs of flexible "fingers" attach the support securely to the instrument, as shown in the accompanying illustration. . . . HOES, RAKES, BRUSHES, BROOMS, AND MOPS are converted into two-handed implements, with a supplementary handle devised by Jacob M. Tweit of Holcombe, Wis. Instead of having to bend over to use both hands, the user works from a comfortable standing position. In addition, the extra leverage makes light tasks out of hard ones. For use, an opening in the curved shank of the extra handle is slipped over and down the regular one. After the grip has been adjusted to the most convenient position, it may be locked securely in place by tightening



ing a wing nut. The user has the choice of placing it at either side of the shaft, so that it will serve a left-handed or right-handed person with equal facility. In the illustration, the labor-saving device is shown attached to a hoe. . . . WHEN HE WANTS TO PLAY three saxophones at once, nothing can stop Bill G. Trew, of Steubenville, Ohio. Any little mechanical difficulties

you'd think might arise are all disposed of in his Multiple Saxophone Unit, patent 2,232,151. He mounts his three instruments on a single stand, adjusting them so that

*(Continued on page 22)*



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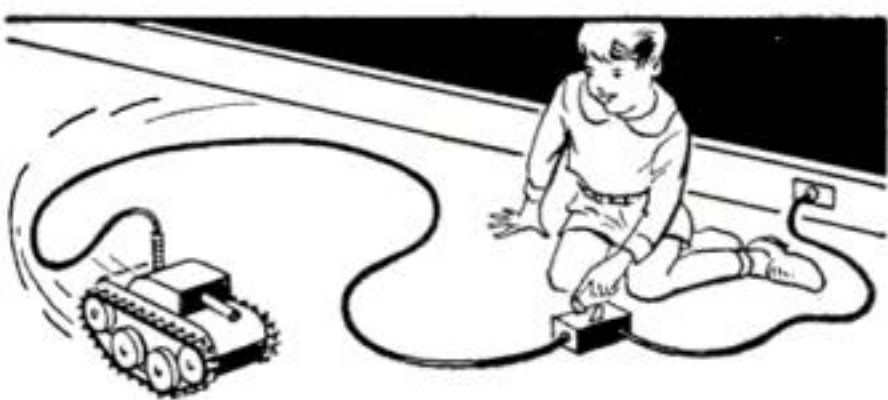
(Continued from page 20)

their mouthpieces converge. With one hand, he fingers the saxophone at his left; with the other hand, the one at his right. As for the one in the middle, he plays it with his feet. To adapt the instruments to his un-



usual purpose, he has devised tricky bars and keys never dreamed of by other red-hot saxophone artists. Cords or wires connect toe and heel treadles to the keys of the foot-operated horn. According to Trew, the combination sounds like something—if and when you master the technique of working more than 500 parts described in

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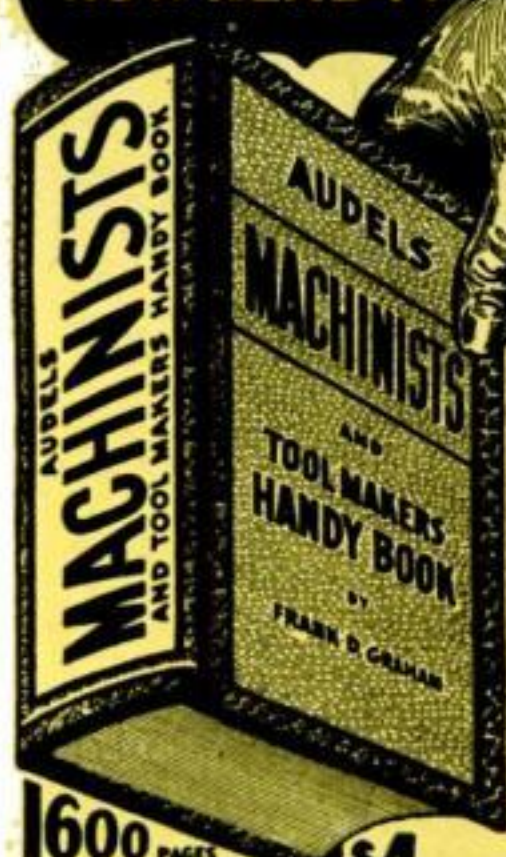
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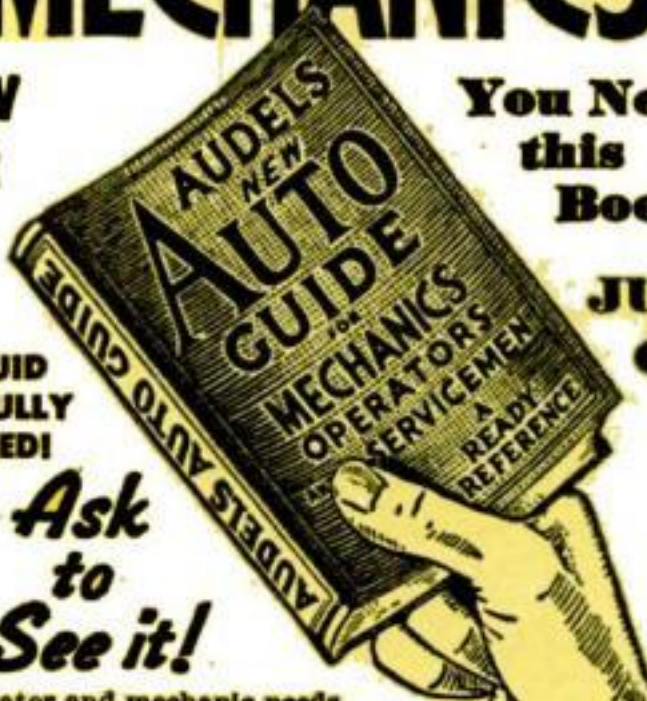
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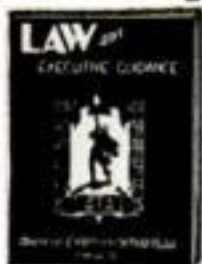
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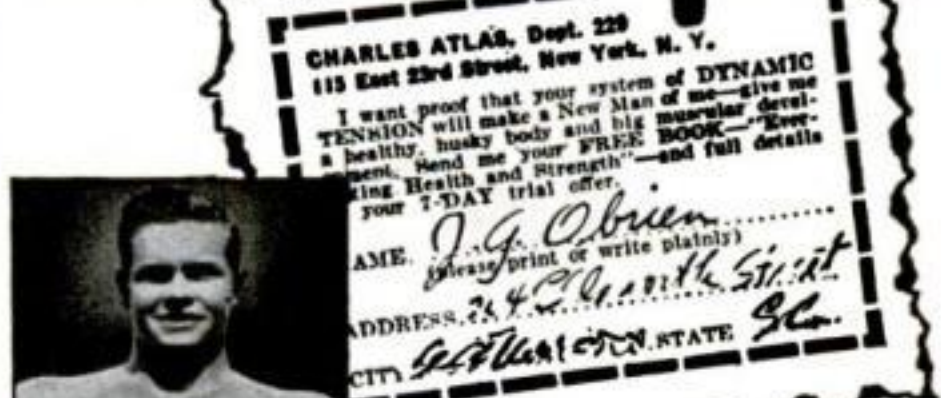
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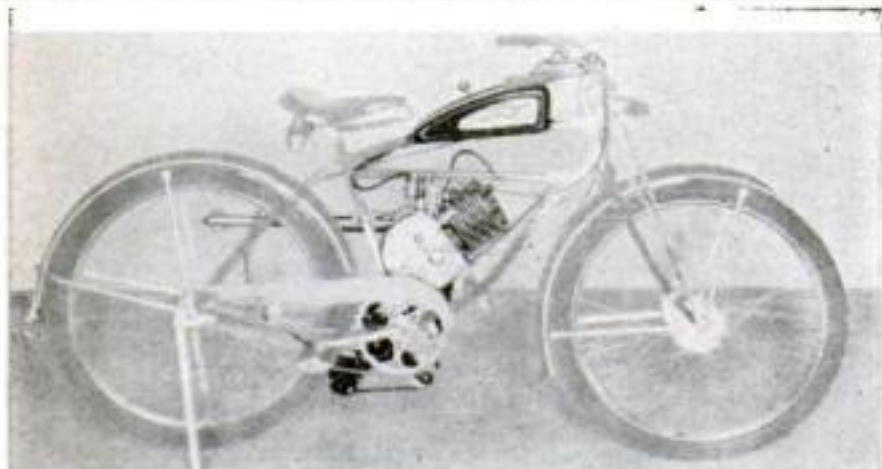
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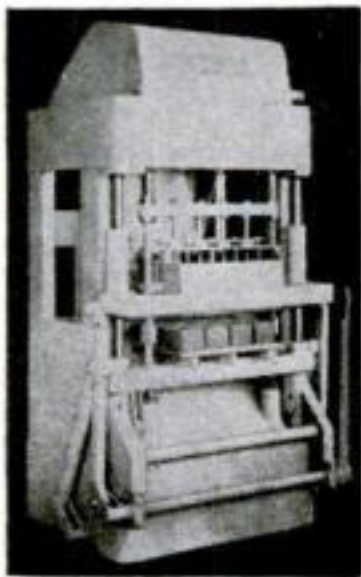
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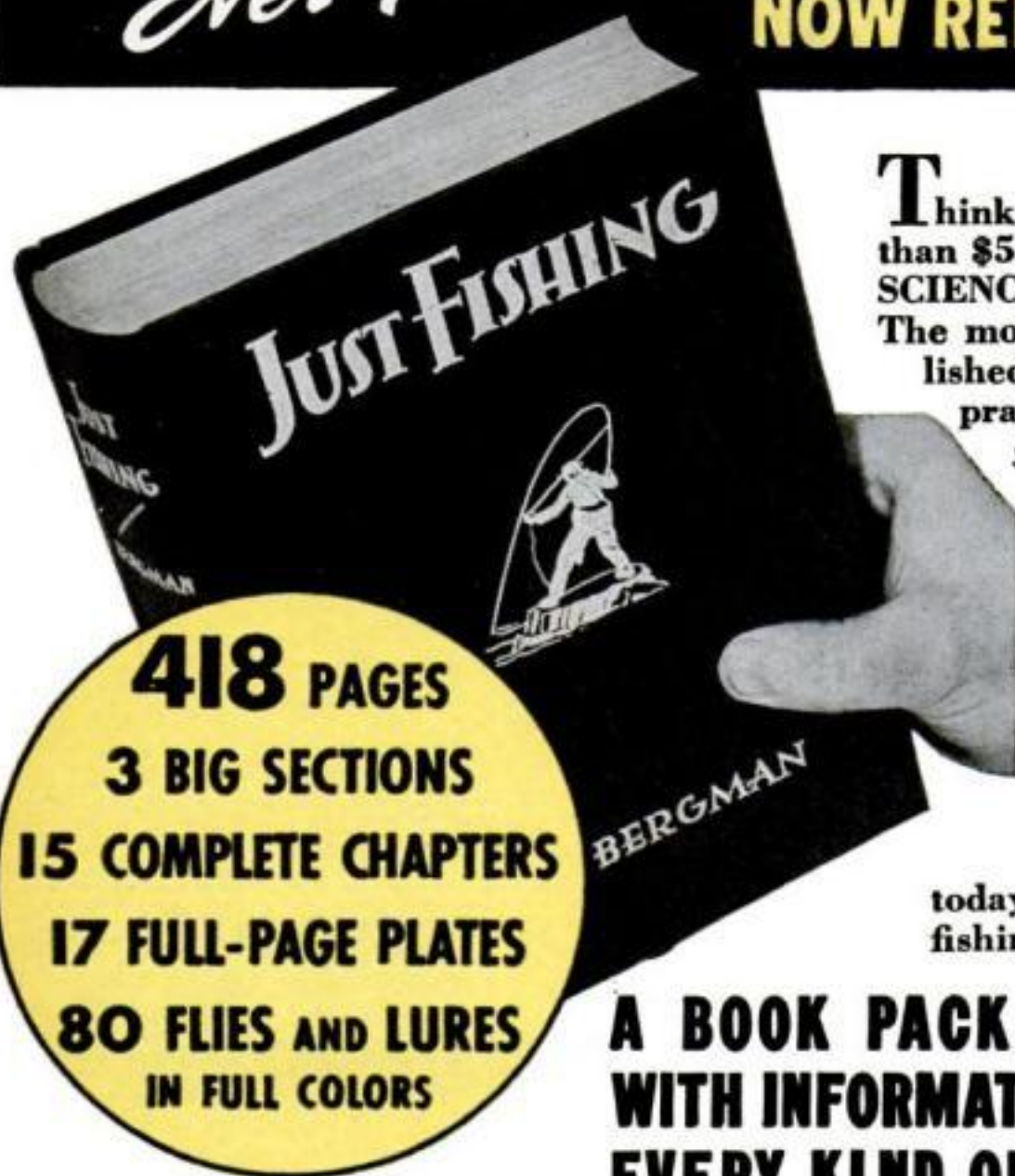
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8 ENLARGEMENTS and film developed. 116 size or smaller, 25c coin; enlarged prints 3c each; special offer: enclose advertisement and negative for hand-colored enlargement free with order 25c or more. Enlarge Photo, Box 791, Dept. PS, Boston, Mass.

FOR the discriminating amateur—8 exposure rolls, 2 prints each 25c. Miniature rolls enlarged 3 to 6 times, 8 exposures 25c, 16 exposures 50c, 35MM 36 exposures, 3x4 enlargements \$1.00. Unexcelled quality, prompt service. Paramount Photo, 327 E. 92nd St., New York.

40,000 SATISFIED Customers! Rolls film machine developed—no scratches or finger marks. Your choice, two professional enlargements and eight fadeproof prints or (16 prints) 25c. Many other bargain offers. Finerfotos, Box 898-18, Minneapolis, Minn.

OIL coloring photographs a fascinating hobby or profitable business. Learn at home. Easy simplified method. Previous experience unnecessary. Send for free information and requirements. National Art School, 1315 Michigan, Dept. 172C, Chicago.

SPEED Service pictures mailed same day received. Sixteen deckled-edge prints from roll 25c. One colored or two plain enlargements plus 8 deckled-edge Velox prints only 25c. Tops Photo, 1201-05 Ogden Ave., New York City.

VELOX Supertone Fadeless Prints. Inspected and guaranteed 20 reprints 25c, 100 or more 1c each. Roll developed, 2 sets prints and 2 professional enlargements 25c. King Studio, PSM2, Sweetwater, Texas.

ROLL developed and 8 beautiful enlargements 2 to 6 times larger—deckled edge—high gloss. Any 8 exposure roll 25c coin. Reprint enlargements 3c each. Alden Photos, 258-C Astor Station, Boston, Mass.

ROLLS developed and 4x6 oversize glossy Velox prints 8 exposure 25c, 12 exposure 35c, 16 exposure 50c. Overnight service. Clemet Photo Service, 1318 W. Columbia Ave., Philadelphia, Pa.

35MM ROLLS fine grain developed and enlarged to 3 1/2 x 5 1/8 exposure 60c, 36 exposure \$1.00. Two 5x7s free. Guaranteed. Texas Studios, Dept. 35-2, Sweetwater, Texas.

18 SPARKLING Lifetone Prints, 3 Hollywood Enlargement coupon (Ivory frames free) each roll 25c. Finished 3 hours, 18 reprints 25c. 75—\$1.00. Overnight Studio, Albany, Wis.

TWO Sets of "Deckledge" Prints with every roll finished—25c. Very finest quality. Deckledge reprints 2c each. Brown Photo Company, 1910-60 Emerson, Minneapolis, Minn.

100 VELOX Deckle Edge Reprints \$1.00. Roll developed, 16 prints and 1 professional enlargement, 25c. Same day service, satisfaction guaranteed. Superior Finishers, Monroe, Wis.

36 EXPOSURE 35MM roll developed. Vaporated, enlarged to 3x4, \$1.00! Send rolls or write for Free book, "Secrets of Shooting Better Pictures". Superlabs, Box 500-S, Elroy, Wis.

QUALITY developing—prompt service. Rolls developed two prints each negative, free enlargement coupon, 25c. Postcard brings mailer. Petyt Studios, Dept. 11-H, 3310 W. 65th St., Chicago.

ROLLS developed. Two sets prints plus enlargement coupon, 25c. Reprints, 3c. Over 19 reprints, 2 1/2c. Jones Studios, Davenport, Iowa. "Where the West Begins."

ROLLS developed, two prints each and two free enlargement coupons, 25c; reprints, 2c each; 100 or more, 1c. Summers' Studio, Unionville, Mo.

IDEAL Photos beautifully finished wide border deckle edge, 25c, roll of 8 and free enlargement. Ideal Photos, Box 2255, Paterson, N. J.

TWO beautiful prints from each picture on roll 25c. Twenty years of satisfied customers. Quick Service, Lens Photos, Dept. J-9, Janesville, Wis.

ROLLS developed—25c coin. Two 5x7 double weight professional enlargements, 8 gloss deckle edge prints, Club Photo Service, Dept. 21, LaCrosse, Wis.

ROLL Developed, 8 brilliant fadeproof Velox prints and two professional enlargements 25c. Overnight service. Young Photo Service, 406-C, Albany, N. Y.

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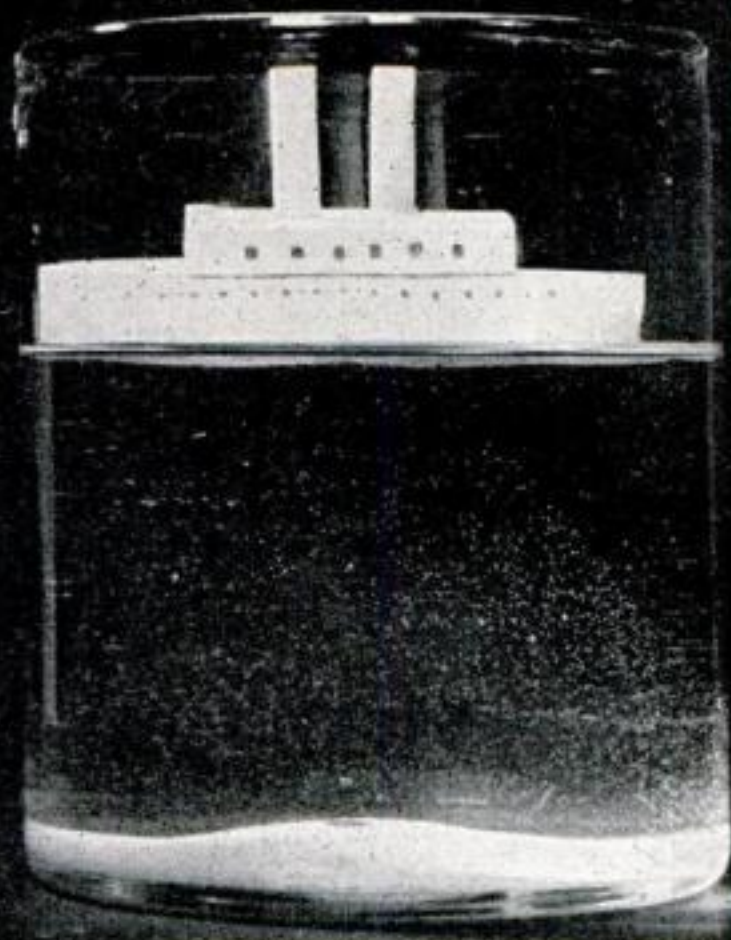
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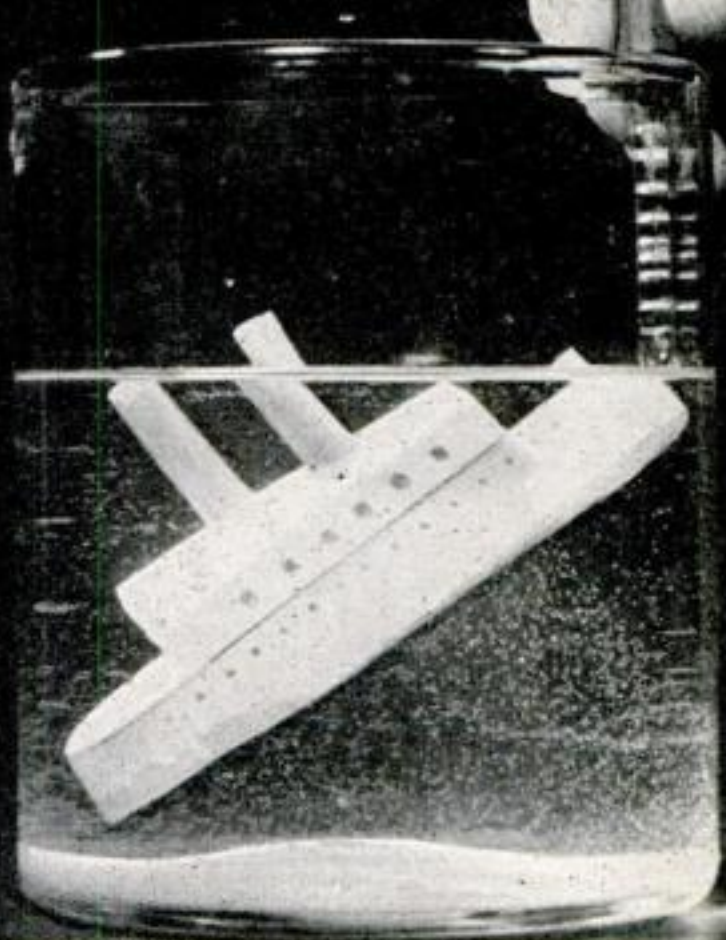
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Surface tension supports this paper ship on ordinary water



...but a few drops of Aerosol send it right to the bottom



# MAGIC CHEMICAL MAKES *Wetter Water*

FOR A THOUSAND JOBS IN HOME AND INDUSTRY

By KENNETH M. SWEZEY

FROM dyeing textiles to fighting brush fires, from soothing sore throats to preventing dust explosions in coal mines, water made "wetter," by means of a magic synthetic chemical, is helping to perform a thousand industrial and home jobs cheaper, better, and easier. Known as Aerosol OT-100%, this strange product of laboratory wizardry is by far the most powerful "wetting agent" ever made commercially available.

To most of us, water is synonymous with wetness. To the industrial chemist, however, plain water is often perversely "dry." Try to color feathers in water dye, for instance, and the dye rolls merrily off. Spray insecticide on crops, and the solutions collect stubbornly in drops, leaving large leaf areas unprotected. Attempts to clean fabrics, metals, and glassware with water mixtures are often thwarted by the resistance of water to wetting the dirt.

The reason for this inability of water to wet many things is surface tension, the molecular force at a water surface which tends to prevent the surface from breaking and spreading. When a surface coming in contact with water has sufficient attraction for water to break this tension, the surface is wetted. When an oily, or otherwise water-repellent surface contacts the water, the water surface remains intact, and the foreign surface remains dry.

Technically, Aerosol is a dioctyl ester of sodium sulfosuccinate, an amazing organic compound created in the laboratories of the American Cyanamid Company. In its pure form it is a solid, resembling paraffin in appearance. For home or small-scale commercial use, it is sold as a 10% clear solution, dissolved in water and a mutual solvent. The cost in this form is from 60 cents to a dollar a pint.

Designed as deliberately as an architect would design a house, the molecules of Aerosol OT are chainlike affairs, having a water-



soluble group near the middle, and a longer oil-soluble group on each end. When such molecules are mixed in water, the water-soluble portion has a tendency to cling to the water, while the oil-soluble portions are attracted to any surface with which the solution comes in contact.

An amazing characteristic of Aerosol is the minute quantity required for results. Mix one part in 10,000 parts of water, and the surface tension of the water will be cut nearly in half; mix one part in 1,000,000, and the tension will still be reduced one-third!

Adopted almost immediately by the textile industry, where the need for wetter water enters almost every operation of manufacture, the use of Aerosol quickly spread to other industries. Paint manufacturers used it to help disperse pigments in oil, and to control paint textures. A number of foundry processes were improved by the use of small quantities of the chemical in wetting foundry sand and in emulsifying the water and linseed oil ordinarily used as a core binder. In all kinds of dry-cleaning and wet-cleaning, Aerosol made operations quicker and more thorough.

Today Aerosol finds uses as strange and varied as hair washes, galvanizing fluxes, printing inks, wheat sterilization, tobacco flavor penetration, insect sprays, cough mixtures, antiseptics, cosmetics, metal plating, asphalt road emulsions, and photography. The Pennsylvania Forestry Department uses small quantities of Aerosol in water to fight brush fires. The Mount Wilson Observatory staff uses it to clean the surface of the 100-inch telescope mirror before resilvering it. An instrument company is adding it to the solution in airplane manometer tubes to speed up the response of the liquid.

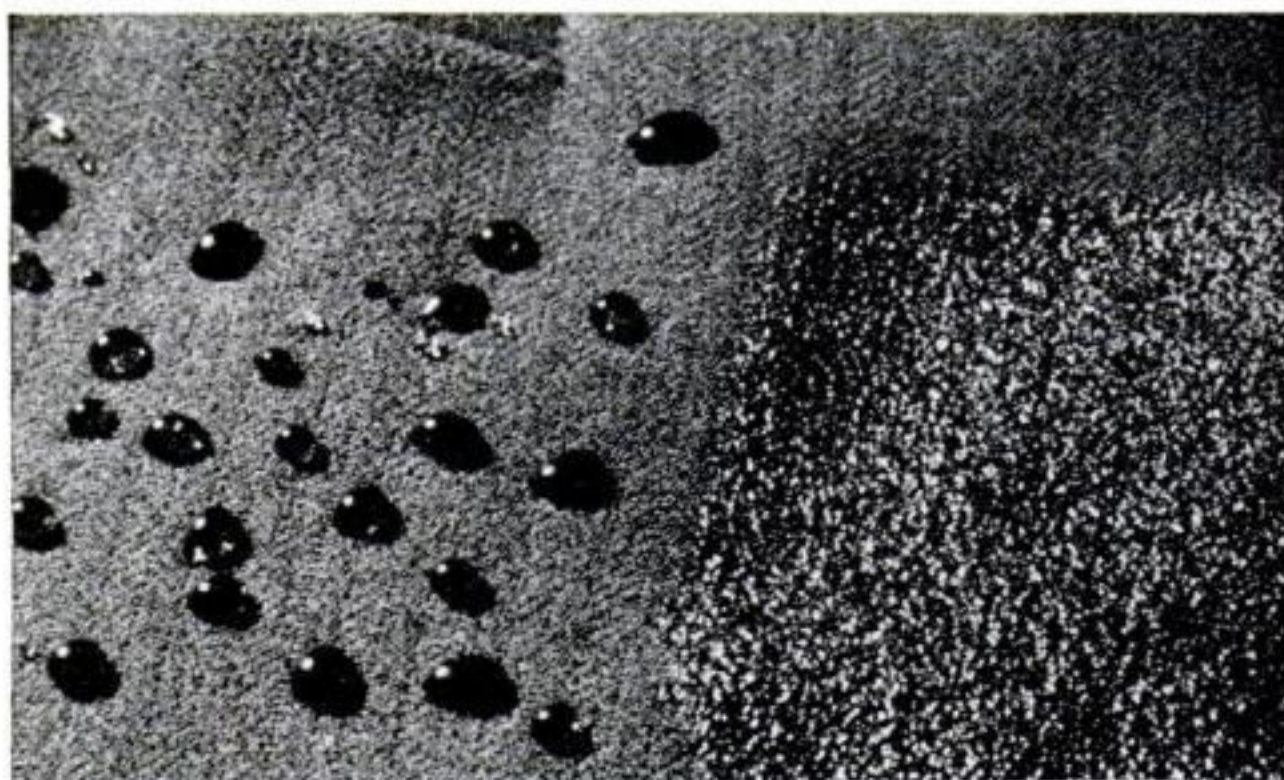
As an accessory agent, Aerosol OT-10% clear, finds many uses in the home. Mix a quarter of an ounce in a gallon of water, and you have an excellent cleaner for windows, car windshields, spectacles, and glassware of all kinds. In the same dilution it makes a good wash for the car body.

Three ounces in a gallon of water makes a



## CHEMICAL:

In its pure form, Aerosol OT-100%, the magic chemical resembles paraffin. It is the most powerful wetting agent available commercially



## RESULT:

A little dissolved in water overcomes the resistance of fabrics to wetting, as seen above. At left is plain water; right, "wetter water"

fine rug shampoo. A small area of the rug is scrubbed with a brush to produce a copious suds, which are removed with a damp cloth. Because it is neutral, it is not harmful if it dries into the rug.

Ordinary ink may be made to write satisfactorily on glass by adding a very minute quantity of Aerosol, the exact amount depending upon the ink. A little added to carbon tetrachloride makes a good cleaner for typewriter type.

To help remove wall paper that sticks obstinately to the wall, wet down the paper with water containing one ounce of 10% Aerosol to the gallon. For a good non-alkaline aluminum cleaner, that may also be





## WASH

Three ounces of 10% Aerosol solution in a gallon of water makes a fine shampoo for rugs. Neutral, it needs no rinsing

## DYE

Waxed cardboard, at left, repels dye dissolved in plain water. At right, it soaks up dye in water made wetter with Aerosol



## CLEANER

Added to carbon tetrachloride, the magic chemical makes even this powerful cleaner do its work better, as on typewriter type

## INK

You can write on glass with ordinary ink to which a little Aerosol has been added. The amount required depends upon the ink

used for all kinds of porcelain and tile, mix five percent with 95% feldspar (200 mesh).

Amateur and professional photographers are now finding dozens of uses for wetter water. Mix 10% Aerosol in the film developer in a proportion of one or two parts in 1,000, and the developer wets the film quickly and evenly, reducing the danger of "pinholes" due to air bubbles or specks of unwetted dust. Mix it in the paper developer, and prints wet almost instantly and uniformly. And less developer is needed.

In the paper-fixing bath, where prints are often piled on top of each other, the addition of about .025% Aerosol greatly increases the chances of thorough fixing. In

strength of .01-.05% (depending upon hardness of water), it speeds up such jobs as intensification, reduction, toning, and sensitizing. It eliminates the need for preliminary wetting, and produces greater uniformity.

Perhaps one of the greatest darkroom possibilities of wetter water is in the prevention of water spots in the drying of film. The uneven drying caused by globules of the wash water collecting on the surface often produces permanent marks on the film. If the negatives, after washing, are immersed for a minute or two in a .05% solution of Aerosol, then given a quick rinse under running water, they may be hung up to dry without being swabbed.





Ed Barbehenn, an engineer, is an air spotter in Maplewood, N. J. His post is the municipal building tower

# Y What You Should Know About YOUR JOB IN CIVILIAN DEFENSE

By DAVID M. STEARNS

FROM the nation's capital out to the last whistle stop in the rural areas, civilian defense organizations are swinging into motion. Manned by volunteers, they are mobilizing the country's men and materials in preparation for any emergency that may come along. Air-raid drills, blackouts, plane spotters, first-aid units, emergency housing committees, auxiliary police and fire organ-

izations—they are all part of the picture that is rapidly being projected on American community life.

Organizing the entire population of the nation into a defense set-up that will provide a maximum of protection with a minimum upsetting of normal life is too big a job for one man. And it can't be done by passing laws, either. To be successful it requires the coöperation of every citizen. Each village, town, or city is an important link, and each has problems of its own that will



Date \_\_\_\_\_

MAPLEWOOD DEFENSE COUNCIL  
QUESTIONNAIRE

LAST NAME (Print) \_\_\_\_\_ First \_\_\_\_\_ Middle \_\_\_\_\_

Home Address \_\_\_\_\_ Tel. \_\_\_\_\_ Bus. \_\_\_\_\_

Age \_\_\_\_\_ Height \_\_\_\_\_ Weight \_\_\_\_\_ Birthplace \_\_\_\_\_

Citizen \_\_\_\_\_ Date of First Papers \_\_\_\_\_ Naturalization Date \_\_\_\_\_

Nationality of Father \_\_\_\_\_ Mother \_\_\_\_\_

Languages you read or speak: \_\_\_\_\_

No. cars you own \_\_\_\_\_; Passenger capacity \_\_\_\_\_

Station Wagon \_\_\_\_\_ Motor Cycle \_\_\_\_\_ Truck \_\_\_\_\_

Will you volunteer use of any of above in an others? \_\_\_\_\_. If so, state which with licensed driver(s), be available during \_\_\_\_\_

State no. persons in your family \_\_\_\_\_; adult children under 12 \_\_\_\_\_; invalids \_\_\_\_\_. How in industry working on Federal defense contr \_\_\_\_\_

Have you ever completed any American Red Cross First Aid Training and where?Standard Course \_\_\_\_\_ Instructor's Course \_\_\_\_\_  
Will you volunteer \_\_\_\_\_Have you had \_\_\_\_\_ you believe would be useful  
to Maplewood \_\_\_\_\_

Have you had \_\_\_\_\_ experience? (specify) \_\_\_\_\_

What are your \_\_\_\_\_

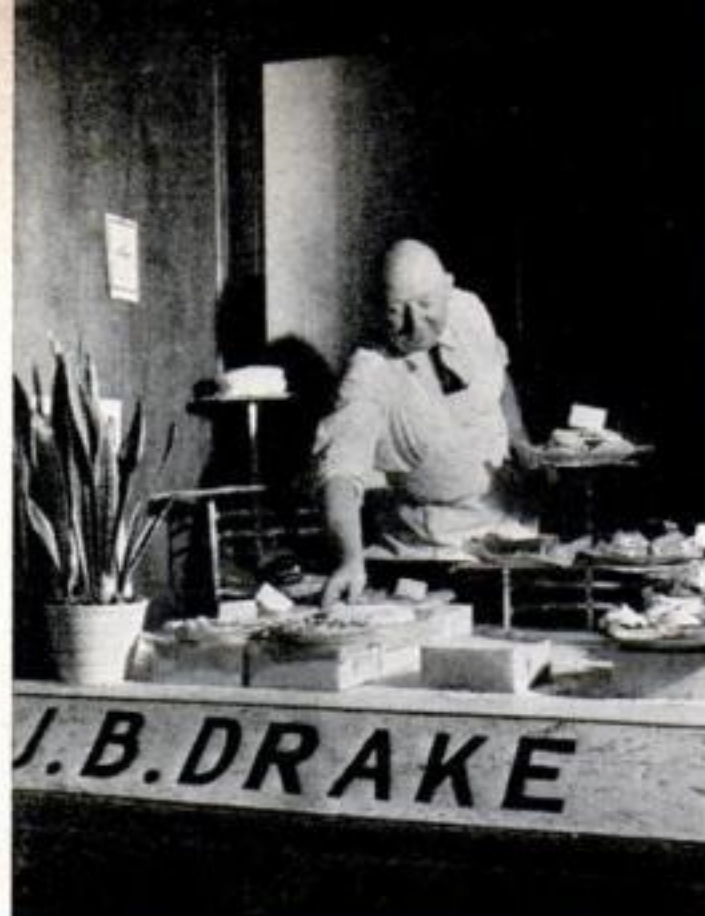
Military experience \_\_\_\_\_

General Remarks or Suggestions: (continue on \_\_\_\_\_)

Indicate defense work you are most capable of \_\_\_\_\_Return to:  
Maplewood Defense Council, Shelter House, Du \_\_\_\_\_

**MOBILIZING AN AMERICAN COMMUNITY:** Here's how a typical American town went about mustering its manpower (and that means womanpower, too) and the necessary equipment to meet any emergency that may arise in the uncertain times ahead. By means of a questionnaire, citizens registered their special qualifications and volunteered for defense services. Station wagons (handy as ambulances) were listed with their drivers; first-aid groups were trained, and a Military Police Reserve Unit was quickly organized





They're all ready for service: Mrs. Alan R. Kemp, at left, is signed up to drive the family station wagon as an ambulance. Dr. E. J. Schneider, a dentist, is a member of the Advisory Committee, which works out any problems with the Defense Council, John B. Drake, a baker, is in the Intelligence Division



As emergency first-aid units are organized, their members take courses in caring for the injured, under a Red Cross instructor. Below, prospective stretcher bearers practice the art of maneuvering a litter with a "casualty" into a station wagon serving as an ambulance



have to be solved by its own residents in time of war. That is why it is a task that has to be done by the myriad local defense councils that are now slipping into harness and getting to work.

In general, these are under the Office of Civilian Defense in Washington, which suggests plans for solving common problems. Below that are regional and state organizations, which in turn pass advice, and in some cases orders, along to the municipal organizations below them. With the state councils rests the task of coördinating the efforts of the smaller units. If one town should be badly knocked about, the state officials must know where to go among the surrounding communities to find assistance for it. If a town has to be evacuated, state officials must know where the unfortunate residents can go for shelter.





Some states still leave it up to the municipalities to organize their defense councils. Other states, like New Jersey, have passed laws requiring each community to appoint a defense council. If they fail to do so, the state defense council steps in and does it for them. It's still a volunteer job, however, because even if the state designates local defense officials, the latter will, in most cases, serve without pay.

In many communities, questionnaires have already been sent to every householder, requesting detailed information on how many persons there are in the family, their ages and the state of their health, how many cars, motorcycles, trucks, or busses he owns, what kind of defense work he and his family are capable of doing, and for what they are willing to volunteer.

All such information, and much more, is necessary to give the local defense councils the knowledge with which they can plan how they will go about evacuating the town, if that becomes necessary, or how many persons will have to be fed and housed if the town is bombed or cut off from its normal source of supplies. First-aid workers must be recruited, or if there are not enough persons trained for that type of work, instruction must be given to volunteers. Things like that can't wait until the bombs start falling if they are to be effective.

To get a first-hand impression of how Americans are going about their new job of organizing for home defense, *POPULAR SCIENCE MONTHLY* visited a town in New Jersey. It might have been in Georgia, Maine, or California, and what was found there

may be duplicated in your own community. If it hasn't been yet, it probably will be before long.

The town picked was Maplewood, a residential community with a population of 22,000 persons and a lot of civic pride. More than 1,000 of those persons have already signed up for some form of defense work, and more are enrolling daily.

The Maplewood Defense Council, which guides their activities, is made up of the kind of men who might be doing a similar job in almost any American town. Its membership includes a florist, an insurance salesman, the operator of an automobile agency, a dentist, an engineer, and the director of the town's community service organization. The chairman is employed by a textile firm, and commutes to work every day. They are all family men and have lived in the town long enough to be well acquainted with it. None of them was a trained defense worker when the council was appointed last November, but by devoting their free time and some money out of their own pockets to the task, they have learned a lot about home defense by now.

The council's first task was to survey the town's assets, in the shape of the skills and the material possessions of its inhabitants. That called for a questionnaire. The information gleaned from these, one of which was sent to every house in Maplewood, was carefully indexed and cross-indexed in a file at the council headquarters, with a duplicate file kept up to date in case anything should happen to the master file.

First-aid classes were the first units to

A suburban community, Maplewood is well provided with station wagons. Vehicles and drivers are registered



In case of a blackout, district wardens would check up on the job and warn residents who had failed to dim all their lights





Maplewood's arm-band insignia. Top to bottom: Transportation Division, Defense Volunteers (Military Police), Intelligence Division, District Warden, Canteen Unit, First Aid, Emergency Housing



Worn like this, with either regular clothing or a special uniform, they would identify defense workers at a glance and show which service they were in. This is the band of the Transportation Division

start training under the council's direction. Volunteers for this work were called out by announcements at club meetings, in the newspapers, and from the pulpits. The very first class had an attendance of 70 persons, and since then more than 400 have completed Red Cross first-aid courses, and more are now taking them.

Next the town's station-wagon owners were polled, and 24 out of a possible 40 volunteered the use of their vehicles as ambulances. In most cases the owner or a member of his family volunteered as a driver. With the first-aid workers who had completed their training courses, these were organized into first-aid units ready to go anywhere at practically any time.

To guard the town's public utilities and property and to perform patrol duty when necessary, a military police reserve unit was formed. This group, now more than 100 strong, is made up of able-bodied men between 18 and 42 years old. All must attend weekly meetings and drills, or give a written excuse for absence. Too many unexplained absences, and they are dropped from the rolls. The men have all agreed not to hold the town responsible for any injury that may result from their defense work, and to report for full-time duty at the call of the council.

Before enlistment, each member had to pass a rigid physical examination, and if accepted, his fingerprints were taken at the local police station and then filed with the Federal Bureau of Investigation. Each member has to pay for his own uniform, similar to the Regular Army uniforms with the exception of a gray instead of a khaki

or olive drab shirt, but the town buys his riot stick and pistol out of a \$2,500 appropriation for defense work. Under the leadership of Major Charles Coburn, a Maplewood real-estate broker who served with the New Jersey National Guard field artillery in the last war, this group could now give pointers to many an Army outfit when it comes to drilling and military procedure.

All municipal buildings in the town have been inspected and their usefulness as emergency shelters is listed at council headquarters. Members of the Maplewood American Legion Post have been assigned to each building so that some one will always be on hand to open the buildings and supervise their use in time of emergency. Registration cards are kept in all such places so that all persons taking shelter there can be listed, and the information filed at headquarters. That simplifies the problem of finding missing members of worried families that have been separated.

Canteens for emergency feeding have been organized at churches and clubs. The amateur radio operators of the town have been formed into a communications net that will continue to function even if all regular channels are disrupted. Boy and Girl Scouts, already trained in many fields useful in time of emergency, are on call whenever they are needed.

To make sure that no undesirable characters work their way into the defense organization, the council has an intelligence division, with "under cover" representatives scattered throughout the other branches of the volunteer workers. Only their superiors and the F.B.I. *(Continued on page 212)*





Men who have volunteered for the Military Police Reserve Unit (Defense Volunteers) get a stiff physical exam in the basement of the Junior High School . . .



. . . and those who pass are taken to police headquarters to be fingerprinted. This organization would help police to keep order in an emergency



Much of their drilling is done in the school gymnasium. Military uniforms and discipline are used to give the soldierly bearing and habits of obedience that would make them an effective force in a crisis

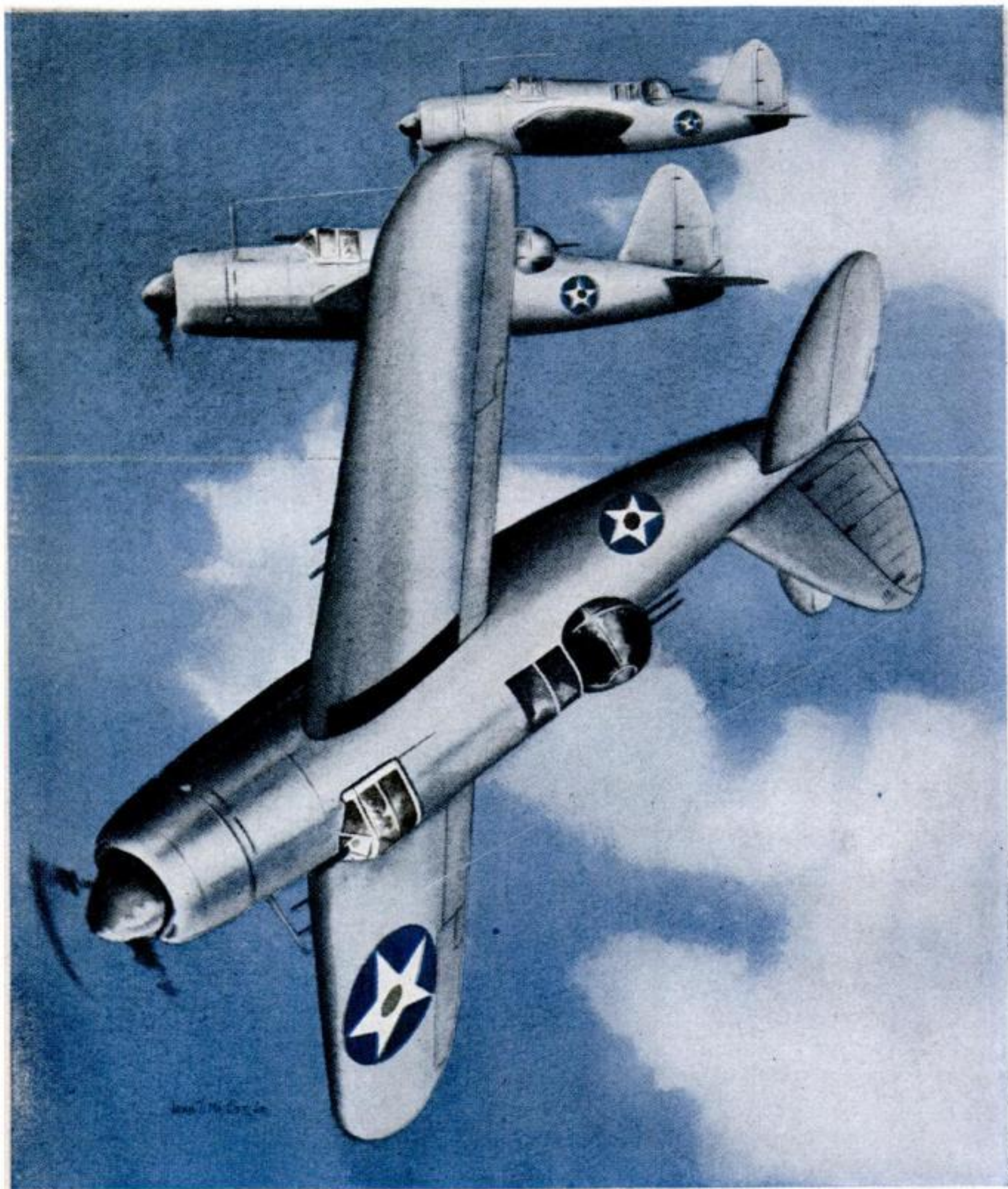
Target practice on the pistol range of the Maplewood Police Department improves the marksmanship of the Defense Volunteers. They must be straight shooters



Policing railway stations would be part of their work in wartime. Here two of them are practicing patrol on the Lackawanna station platform







## Our Cover

THE NAVY'S new Brewster dive bomber, SB2A1, shown on this month's cover, is "peeling off" from its squadron to attack from a height of a mile or more. These planes, in their brilliant peacetime dress, contain such improvements as leakproof gasoline tanks, armor plate, heavier fire power, and power-operated rear gun turrets; four .50 caliber machine guns are in the wings, two in the turret. They appear as based on the carrier, the U. S. S. *Lexington*, the tail empennage (assembly) being painted bright yellow. The squadron's skipper ship and leader of first section is identified by the red ring around the engine and the red band around the fuselage. Above, the same planes are shown in their present wartime dress, with no markings to reveal squadron, base, or carrier. Both paintings were executed by John T. McCoy Jr., noted aviator-painter.





## MAN of the MONTH

Glenn L. Martin, aviator in 1909, bomber builder in 1941

# *From Barnstorming to Bombers*

**A Pioneer Plane Builder Sees His Prophecies Come True**

By **ROGER BURLINGAME**

"THE AEROPLANE will practically decide the war in Europe. Veritable flying death will smash armies, wreck mammoth battleships, and bring the whole world to a vivid realization of the awful possibilities of a few men and a few swift aerial demons. For the old-time war tactics are no more. The generals who realize this quickest and fight first with flying death, will win."

I read this last week in the office of Glenn L. Martin at Middle River, Md. It was a

clipping in a scrapbook. That queer word "aeroplane" made me look up at the date-line. August 7, 1914!

But that was the day of "crates," of cat's-cradle construction, of wooden struts and fabric wings, when the only recognized use for the military "aeroplane" was reconnaissance and observation—perhaps the direction of artillery fire. If bombs were to be dropped, they must be carried by lighter-than-air ships.

I looked out the window and came back, suddenly, to 1941. Out there lay some 40



acres of buildings forming one of the biggest and newest aircraft plants in the country—working three shifts through a 24-hour day for American defense. The factory was owned by the man that made that uncanny 1914 prophecy—Glenn Luther Martin.

The prophecy gave me a key to the mystery of Glenn Martin's astonishing career. It helped me span the years between the 26,625-pound bombers, motored with twin 18-cylinder, 1,850-horsepower motors that come steadily off the Martin production line today, and the fabric-winged, kitelike machines he was making for war use in 1914. It helped me, too, over the years between those crates and a box kite flown in the Kansas wind by a boy of six in 1892.

**S**TANDING out from the prophecy and proved by any investigation of the steady course of this man's life is one all-important fact. From the start, he saw the potentialities of the heavier-than-air flying machine as a war weapon. In all his work with civil aeronautics, he has never lost this early vision or failed to come back to defense as the guiding reference line of his life.

A second fact that must be remembered about Glenn Martin is that, before everything, he has been a manufacturer. The public lost sight of this for a time during his spectacular career as an expert and "daredevil" flyer. Glenn Martin never, for an instant, lost sight of it. He learned to fly because he wanted to understand the design and manufacture of planes. He flew in hundreds of public exhibitions and contests because he wanted to create public confidence in the airplane and so stimulate demand and build markets for the industry. His personal performance in this period is one of the most remarkable demonstrations on record of a manufacturer's faith in his product. Through it all, his factory never stopped producing.

From the present Glenn L. Martin Company plants with their 5,000,000 square feet of floor space and their \$400,000,000 backlog in defense orders to the kite factory in the corner of Mrs. Cyrus Martin's kitchen in Salina, Kans., we must go back nearly half a century. Salina boys had seen the box kite of Glenn's own design and manufacture flying high over the prairie and they wanted kites like it. At six, Glenn Martin began producing them. He worked his production up to three a day and his price to 25 cents.

In his teens, the news came to him of the success of the Wright Brothers at Kitty Hawk. Secretly, then (for such things were not thought healthy-minded), he built himself gliders and prepared himself to make a motored plane.

By his early twenties, he had saved some money. His family had moved to California. In Santa Ana, in 1908, he was ready for his great experiment. He could not make his plane outdoors without danger of being led off to the doctor for a mental test. So he looked for a building with a large room. There must be no posts. Anyone who has seen the Martin plant buildings of 1941 with their 40-foot clearances and their 400-foot steel trusses supported only at the ends, knows what kind of a building he wanted in Santa Ana. He found it. It was a church.

He rented the empty, abandoned Southern Methodist Church for \$12 a month. He painted the windows to keep out spies on his sanity and worked there at night. In the daytime, he was in the automobile business, making money and learning about internal-combustion engines. His mother, who has always been (and still is) a partner in his enterprises, held a kerosene lamp for him to see around, inside and under his machine.

In something over a year, he had completed his first biplane and mounted in it a Ford 15-horsepower automobile engine, adapted for lightness. "I don't know where all those fifteen horses were," he told me. "I never seemed to be able to get them all into the engine at one time." He had to tear out the vestibule of the church to get his plane out. With this machine, highly reminiscent of the box kite, he learned to fly. Then he built another, doubling the horsepower.

All this time he was leading a double life. Part of the time he was a persuasive salesman of Ford and Maxwell cars. With the money he made at this, he was able to start a factory with two or three assistants.

I talked with Charley Day, his first mechanic, who is now Supervisor of Aircraft Production for the Canadian Government.

"**G**LENN used to neglect the automobile business terribly," he told me. "When Friday came around, I used to remind him of our payroll. Glenn would go through his pockets, shake his head, frown, and spend the afternoon selling cars. He always came back with our pay."

In the summer of 1910, a reporter, walking south on Main Street in Santa Ana, saw a queer winged machine on the mesa of the San Joachim Rancho and Martin found himself in the next morning's paper. By that time he had no fear of being called crazy. He could fly as well as the Wrights. The publicity broke just right for him and started him on a long showman's career.

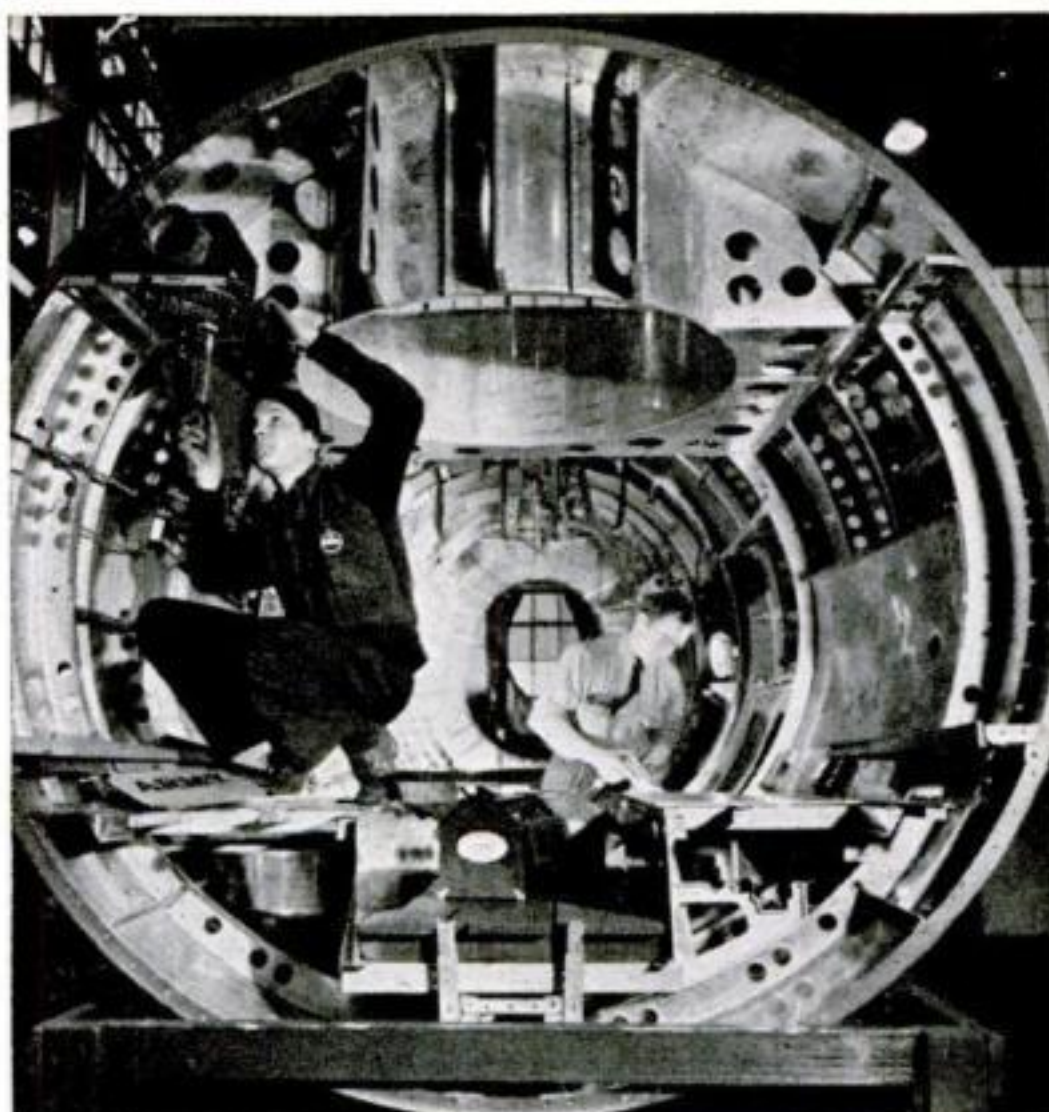
For the next two years the papers were full of his exploits. Before great crowds he staged spectacular flights. He had hundreds of hairbreadth escapes. Sometimes, flying



in fog at night, he was given up for lost. Working always for publicity, not for himself but for the airplane, he threw baseballs from the air, took up cameramen and occasionally (though this was against his monastic tastes) an actress. In sharp contrast to his apparent recklessness in the air, Glenn Martin was the quietest of youths; he never smoked, drank, danced, or swore; he dressed and looked like a Methodist minister, and women alarmed him more than fog over Lake Michigan.

By 1912, flying was a sport. There were many races and other contests which offered cash prizes. Among the competitors, Martin

Instruments and controls of the Martin B-26 bomber requires two miles of wiring. Here workmen are installing equipment in the tail section of one of them



Here's how the B-26 looks when it leaves the factory. A medium bomber, it has greater speed than most of the pursuit planes now fighting Europe's air battles



Another example of Martin's genius for combining speed and maneuverability with load-carrying power is the B-187. Like the B-26, it carries on the tradition of the B-10 which made a sensation in 1932



For the Navy Martin builds giant flying-boat patrol bombers. Designed for defense service in midocean, they have long range and great carrying capacity. The craft shown is the PBM-1







Clad in a fireproof suit, heavy metal shoes, and a helmet that looks like the headpiece of a deep-sea diver, a worker at the Martin plant near Baltimore pours molten metal to be used for die-casting. This is a little-known phase of Martin's job of filling defense orders for aircraft that run into nine figures

was exceptional because he was a manufacturer—indeed he led the field in the industry. His trade mark was on many of the contesting planes. So when he won prize money as a pilot, he had a definite use for it. Every penny beyond the needs of a very frugal living went into the factory, which he had moved, in 1912, to Los Angeles.

Long before the threat of the first World War, Glenn Martin had foreseen the military airplane. In the earliest of the news stories, we find him quoted as recommending flying reconnaissance and observation. But by 1911, he had clearly seen the bomber vision. The U. S. Army, as always, was hard to convince. Martin knew that he must begin by a spectacular public demonstration.

I read the news story of this show. It was in January, 1912. Lincoln Beachey and Howard Gill, famous flyers of the day, took part along with Martin. The exhibition was at night in a great field near Los Angeles in which stage-scenery forts and the "forbidden city" beyond, had been constructed. The paper said that bombs were dropped with the greatest accuracy, destroying the targets while searchlights from warships in the harbor picked out the planes. I found the

story hard to believe and I asked Martin about it.

"It was a fake, of course," he told me. "We couldn't take that kind of chances with an audience as close as that. The bombs we dropped contained no explosives. But I had mines planted under the forts. Every time we dropped one of our harmless bombs, someone would throw a switch and detonate one of the real ones. The real ones had cans of powder attached so there would be plenty of smoke and flame. But it was a realistic demonstration of what plenty of people would see some day."

And the show did what it was meant to do—it attracted the Army. A year later an ordnance officer asked for a private demonstration of real bombing and Martin gave it to him. The colonel built himself a lean-to shelter with an earth parapet so that he could watch the fragmentation.

"I had a pretty primitive bomb sight," Martin told me. "Just a couple of intersecting cross-hairs. When the intersection came over the target I was supposed to let go."

When he came down the colonel said it was fine but asked why the bombs had gone so wide of the target.

"Because every time I looked through the sight," Martin explained to him, "all I could see was you!"

But in that same month of May, 1913, some astonishing news came from Mexico where the Huerta revolution was going on. On the 28th, the besieged city of Guaymas was bombed from the air, causing great property damage and even loss of life. "The attack of this dragon of war," says the paper, "created a reign of terror such as the city has never seen." This seems to have been the first recorded bombing of a city from a heavier-than-air machine. The aviator was Didier Masson and his ship was a Glenn Martin plane bought in Los Angeles.

That year, 1913, before the world was war-minded, saw the swing of Martin production toward warplanes. The results were the first armored plane and the famous Model TT, a training plane built for the Army. From that point, the armies and navies of the world were his best customers.

Meanwhile, his pioneer work with sea-planes had established the reputation which the U. S. Navy recognizes today in its large contracts for PBM-1 "flying boats." In May, 1912, he made the first over-ocean flights



from the California coast to Catalina Island and back. The total distance was 76 miles. On the way back, he encountered fogs. While these cannot be called "instrument flights" in the modern sense, Martin made full use of what instruments he had and, when the flights were over, he announced that "a perfect course can be followed with clocklike precision."

In July, 1914, on the verge of the World War, the U. S. Army ordered four Martin war planes. Less than a year later, Martin announced, "I have twelve seaplanes ready for Uncle Sam in case of war." In 1916, he forecast recent German tactics by making a plane designed to carry a motorcycle which was to be used for scouting after landing, or to be dropped by parachute.

In the later years of the war, Martin saw his bombing prophecies come true in Europe. He was already working on a bomber for the United States. But he was never satisfied with makeshifts. Rather than turn out a hurried job, he was content to let the Army use the Handley-Page machines developed by the British. So the celebrated "Martin bomber" did not appear until August, 1918. This biplane had a span of 71 feet, 5 inches, was motored by two 400-horsepower Liberty motors, carried a bomb load of 1,500 pounds, four machine guns, a cannon, and a crew of four, had a sea-level speed of 118.5 miles an hour and a range of 635 miles. These were remarkable specifications in 1918. Since that year, when he thoroughly mastered basic bomber technique, Glenn Martin has steadily raised these dimensions.

Having read his 1914 prophecy, I was not surprised to learn that as early as 1919, he had the plans for a torpedo plane for use against ships. This could take off from the deck of a carrier. Two years later, in July, 1921, in a demonstration off the Virginia Capes, Martin bombers sank a battleship, a cruiser, and a destroyer.

Martin reminded me, as I talked to him, that dive bombing, made famous by the German Stukas, was first practiced in the United States. Picking up one of the little models from the table in his office, he showed me precisely how the dive was made, the bomb released and the recovery effected. The first dive bomber which suc-

cessfully carried a 1,000-pound bomb in a terminal-velocity dive was the Martin XT5M-1, which made its first flight on May 17, 1929. After that, the United States unfortunately did not follow up its own invention with the full concentration it merited until Germany had perfected the technique.

It is probable that by 1929, the possibility of dive bombing had occurred to others besides Glenn Martin. But I wonder how many had thought of it in 1914? In that prophecy which I have quoted, he had written:

"It is possible for one man, driving an aeroplane laden with high explosives, to dive like a plummet upon the bows of a great warship and destroy it."

As the thirties came in, military experts were busy discussing speed versus load capacity and it was generally conceded that a bomber must be a slow, lumbering affair in order to carry an effective load. This necessitated a considerable escort of fighter planes so as not to be at the mercy of pursuit ships. But in 1932, the Martin company produced an explosion in all this theory with its B-10, which flew 100 miles per hour faster than any bomber to date and considerably faster than all but a few pursuit planes despite its loaded weight of 17,000 pounds. This performance has been improved in the B-10's immediate successors, the B-10B and the 167, and reaches new peaks



Like a modern Jonah emerging from a flying whale, a workman crawls out of the tail of a B-26 awaiting its turn on the assembly line



# Here's My Story—Glenn L. Martin's Career, Shown Here in Photographs, Parallels Growth of Aviation



Around 1910, crowds gasped at Martin's "daredevil" exhibition flights in rickety crates like this



His first plane factory was an abandoned church at Santa Ana, Calif., which he rented for \$12 a month

Sept 30-10

*For Heavens sake, if you have any influence with that Wild-eyed, Hallucinated, Visionary young man, call him off before he is killed. Have him devote his energies to substantial, feasible and profitable pursuits, leaving Dreaming to the Professional Dreamers. H.H.S*

Flying was not considered sane in those days. The family doctor expressed his unqualified disapproval

The first "newsboy of the air," he flew 100 papers from Fresno to Madera, Calif. (24 miles) in 1912

Three years later, he appeared in a movie with Mary Pickford, drawing \$700 a day for himself and plane

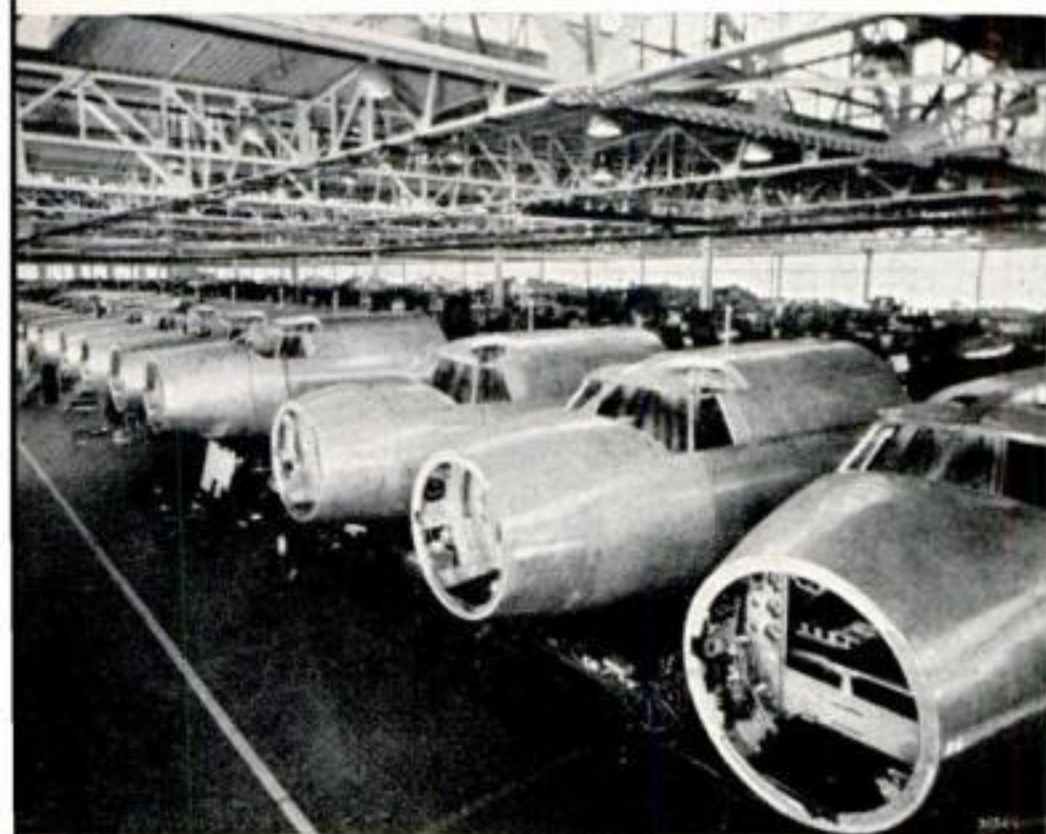




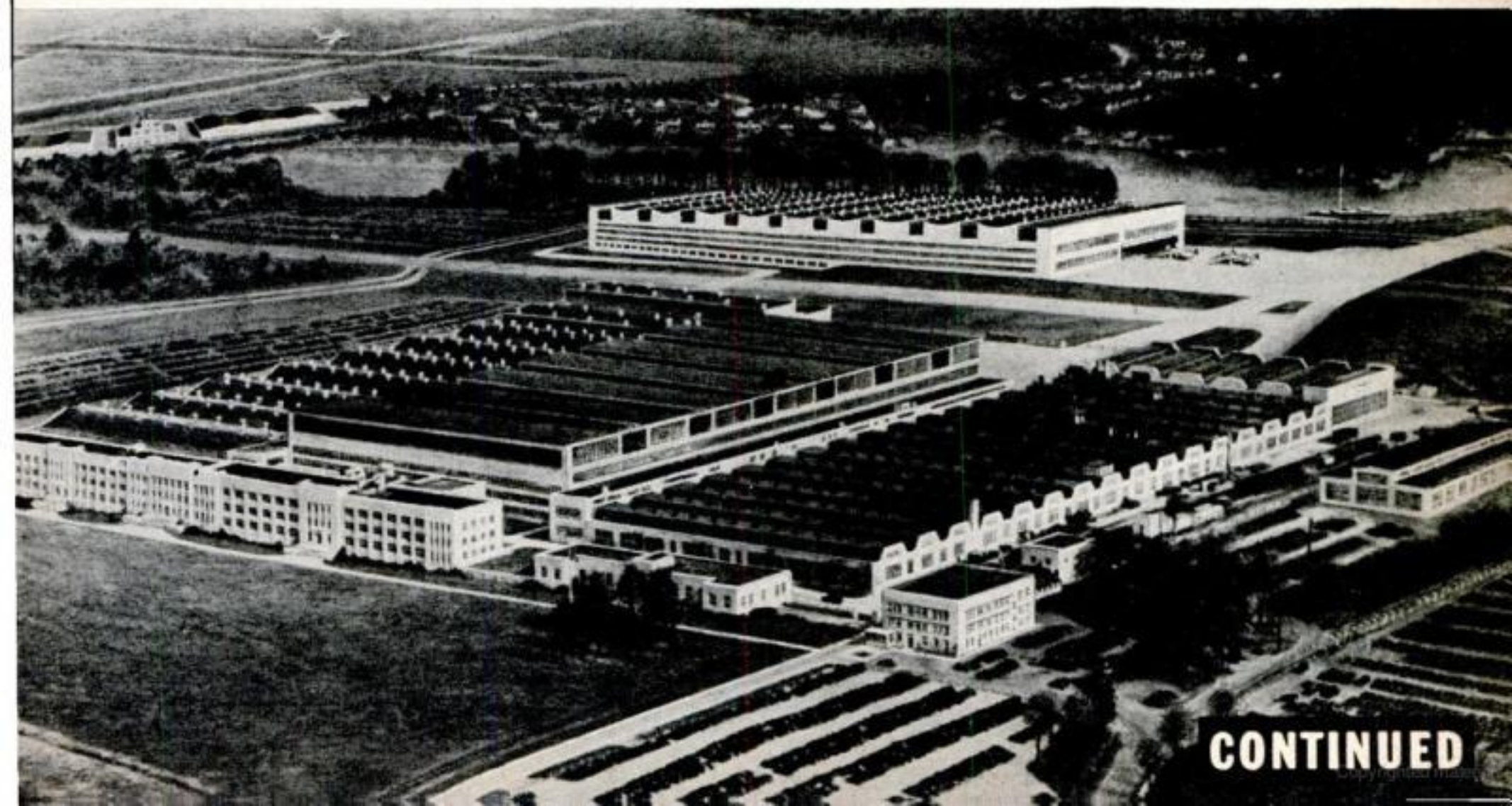


Manufacturing—then and now. Above are shown MB-2 bombers being assembled in 1918. In the view below, nose sections for B-26's are seen lined up in the modern Martin factory. Methods of production have changed as much as planes

... as you can see by comparing the MB-2 in flight above, with its modern descendant. The MB-2 was quite a ship in its day, however, with its two 400-horsepower Liberty motors and its armament of four machine guns and a cannon



Plant No. 1 of the Glenn L. Martin Company at Baltimore. With its forty acres of buildings it employs about 18,000 men working three shifts through a 24-hour day. There is another plant at Omaha, Neb.



**CONTINUED**



in the B-26 and 187 in present production.

To the public, which reads of these achievements, they seem like sudden brainstorms—flashes of inventive genius which come magically at the needed moment. But Glenn Martin does not work that way. His planning is steady and far ahead of demand. Just as, while he was making his first successful "daredevil" flights, he was dreaming of military aircraft, so he knew about the B-10 years before it came. It is well known at the Baltimore plant that the master plan of the B-26 for which the Army contracts now run into nine figures has been lying in the office for some ten years. So, perhaps, if you knew where to look, you could find the working drawings for the 250,000 pound, 80,000-pound bomb-load, 3,000 mile-range plane which is reported to be a Martin project. Martin won't talk about it, beyond the statement that it is a technical possibility. But this long-term planning is as characteristic of him as his silence. With it, he is able to give his engineers full opportunity for production tooling.

**S**PEAKING of tooling, "mass production" is a term which must be applied with caution to airplane manufacture. The plane does not lend itself to the "straight-line" moving-conveyor pattern of the automobile factory, where the chassis is the basic element and parts are successively attached to it. The structure of the plane requires that sub-assemblies shall move in more of a radial pattern toward a central point. This is not a wholly accurate description but it suggests the difference.

But mass-production methods are followed as fully as possible in sub-assemblies, and tooling has been carried far enough to bring great reduction in the comparative number of skilled workers in the Martin plants. Working drawings are made full size on the ship-loft principle, and photographed directly by a giant camera on the metal which is used for jigs and patterns. Every part which is turned out is completely interchangeable with every other similar part so that any wing can be fitted without change into any center fuselage section and so on through the assembly. Martin people boast that the B-26 had no prototype—no experimental hand-built model—but the first ship made was a production ship.

The Martin plants at Baltimore (Middle River) and Omaha are now fully engaged in the production of three types: the B-26, medium bomber for the U. S. Army; the B-187, ("Baltimore") medium bomber for the British and PBM-1, patrol bomber called a "flying boat" for the Navy. Production figures are forbidden (except in terms of dollars) as are the data on speed

and performance. Plans for the immediate future are wholly shrouded in silence.

But Glenn Martin talked more readily about the far future—the time when the emergency will be over.

"I do not see this slump people are talking about," he said. "Such progress in research, in increased efficiency of performance has taken place in the war period owing to the extreme pressure, that when it is over, there will have to be a complete replacement of existing aircraft throughout the world.

"Every government will have to remake its military air force. But in commercial aviation too, there will have to be replacement to adjust to the progress made in war performance."

In other words, the research into the carrying of bomb loads at great speeds has opened up, for instance, long vistas of possibility in the carrying of passenger or cargo loads. Forced fuel economies, maneuverability—a hundred other war necessities make possible immense advances in peacetime transportation. The ability of aircraft to stand up and maneuver under wartime attack and danger will greatly increase their peacetime safety. All these things will help the obsolescence of the present commercial planes.

But when I asked what directions commercial aviation would take after the war, I saw the curtain of silence begin to fall.

"My competitors would like to know what I think about that," he said with a smile. "But I can say this: I have about 18,000 men employed now at this plant. By the end of the year, I expect to have 42,000. But when the emergency is all over, I am confident that I shall still keep 18,000 as a starter for peacetime work."

**I** LEFT him then and went back to the 1914 prophecy. Then I made a prophecy of my own. Whatever his competitors may do, and however great the temptation of commercial aircraft, when the present emergency is over this strange genius will continue to concentrate primarily on the work to which the whole direction of his life has led him. He may digress as he did when he made the Pacific Clippers in 1935. But mainly he will stick to the job that his prophecy forecast—the job that has given this Government such confidence in the planes that bear his name.

He will follow the same dream that has beckoned him on since the days when flying was considered a sport for fools and when military men scoffed at the idea of planes being useful in a war. He will go on building bigger, faster, longer-range bombers.

Glenn Martin will stick to defense.



# PLOW TRAIN BURIES Coast-to-Coast Cable



Snaking over a Nebraska hill, a cable train narrows the gap in the new transcontinental wire line

FOR the first time, transcontinental communication by wire will be safe against disruption by air raids, sabotage, storm, and fire, when an all-underground cable between the Atlantic and Pacific is placed in service by the American Telephone and Telegraph Company. First planned for completion in 1945, the project has been so speeded that only a few months will be needed to close the remaining gap between Omaha, Neb., and Sacramento, Calif.

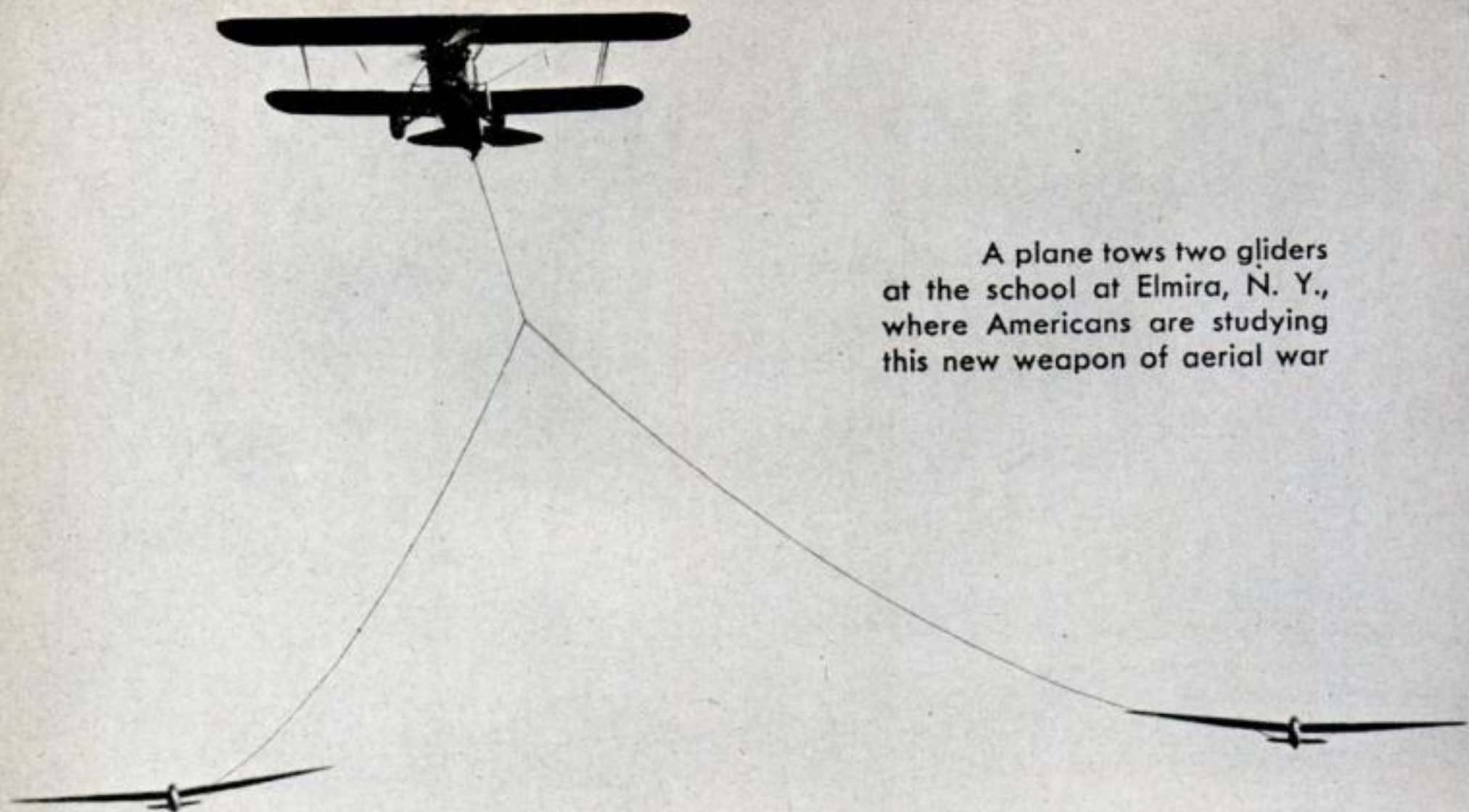
Two caravans of cable-laying tractors, slowly but steadily approaching each other, are constantly narrowing the breach. In one continuous operation, each tractor train plows a deep furrow, plants a pair of cables in it, and covers the furrow again—so smoothly that the covered trench would

escape detection even by "hedgehopping" planes. When the gangs meet, the cables will be joined. One cable contains the wires for west-bound channels, the other for east-bound. Supplementing overhead lines, the underground cable will increase transcontinental facilities at first by 50 percent and eventually by nearly 300 percent, meeting practically any demands for telephone communication between vital centers of industry, railheads, and troop concentration points on either coast. Equipment used will provide 12 talking channels for each two pairs of wires. To amplify the circuits, nearly 100 amplifier stations will be installed along the 1,600-mile Omaha-Sacramento route, which will pass through Denver, Cheyenne, and Salt Lake City.

Nothing short of solid rock or soft swamp can block this caravan, which travels pretty much as the crow flies. It digs a deep trench, lays two cables in it, and fills in the earth in one operation as it crawls across the country







A plane tows two gliders at the school at Elmira, N. Y., where Americans are studying this new weapon of aerial war

## Fighter Pilots Try New Wings

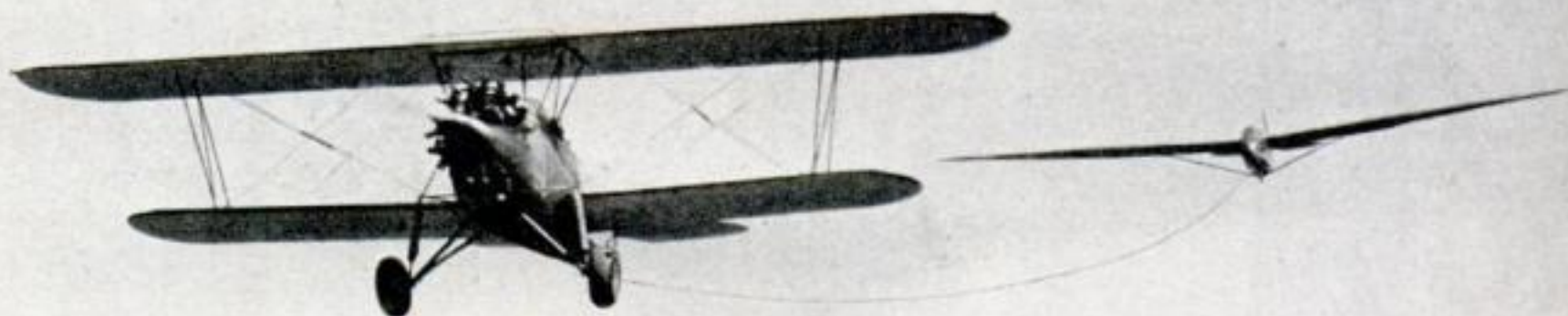
**A**IRMEN of America's fighting forces are learning to use a new kind of wings. Convinced by demonstrations on European battlefields that motorless aircraft can't be overlooked as military weapons, useful for invasion or other purposes, both the Army and the Navy are now experimenting with gliders.

Recent orders assigning Army men to this work were unprecedented, as heretofore the

Air Corps has looked with disdain on motorless flying for its pilots. Air Corps officers have been assigned as observers at soaring contests of The Soaring Society of America, at Elmira, N. Y., to be sure, and individual officers have attended soaring meets out of purely personal interest. But the official Air Corps attitude has been distinctly cold toward the use of gliders for any purposes.

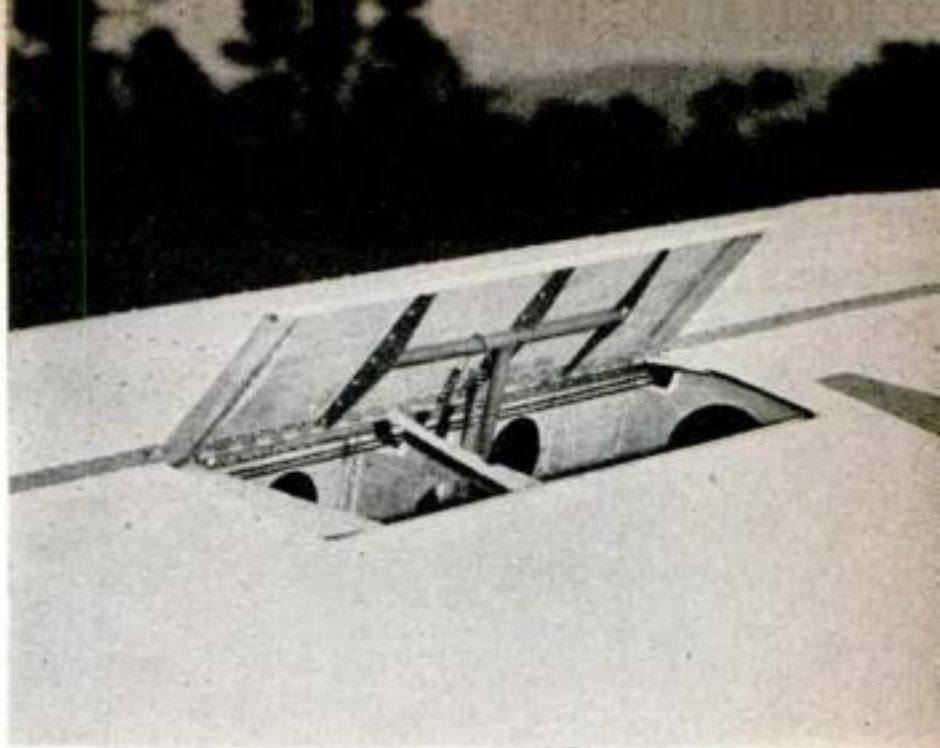
The Navy's entry into this field, isn't so

This is a single tow. Multiple towing is one of the tricky features in the military use of gliders





# Our Army and Navy Flyers Are Sent Back to School To Master Motorless Craft



For the accurate control required by formation flying, glider pilots use "spoilers"—hinged flaps like the air brakes on a power plane. When opened, they kill the airfoil lift to cause turbulence and reduce altitude without gaining air speed



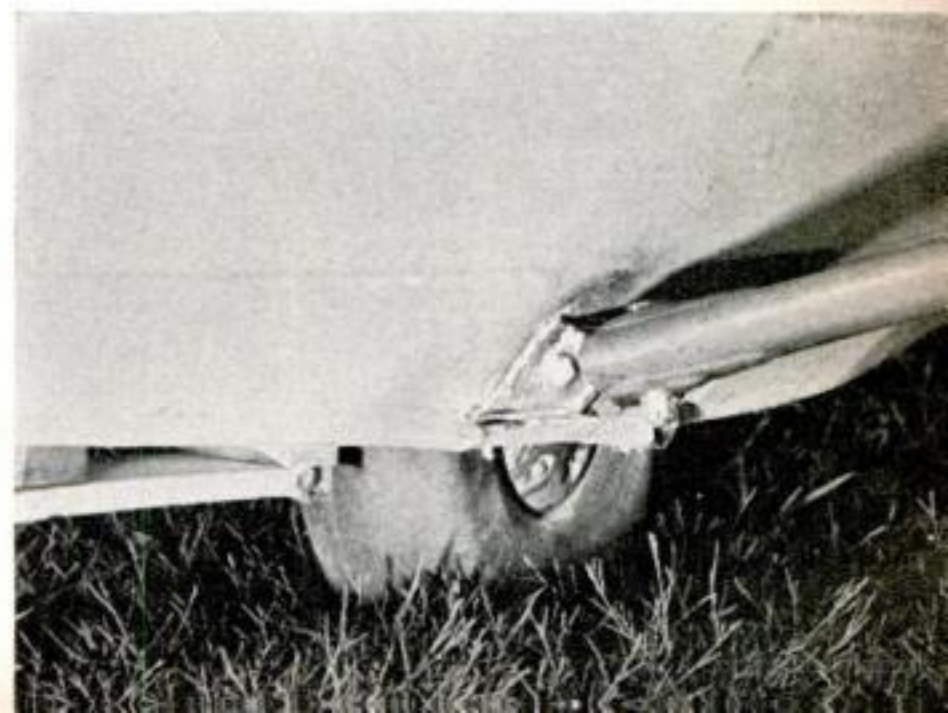
Major J. K. Gerhart climbs aboard a sailplane at the Frankfort-Lewis School of Soaring at Lockport, Ill., where Army flyers are receiving glider instruction



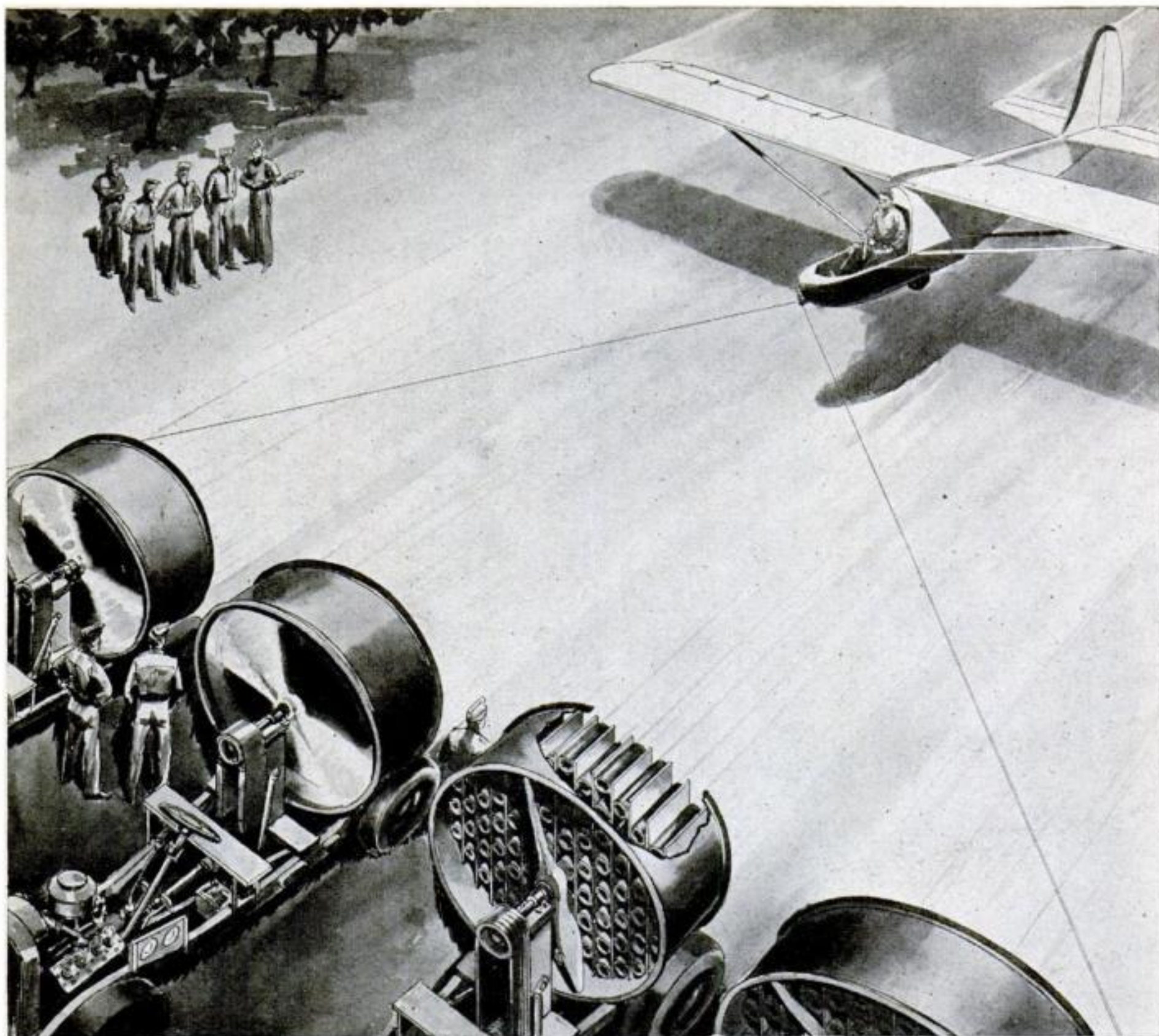
The towing cable is attached to a hook on the fuselage of the glider. When ready to cast off from the towing plane, the flyer releases the cable by a knob on his dash

radical a turn-about in attitude as that of the Army, for in 1934-1935 it did officially carry out experiments with motorless craft at Pensacola. However, those experiments were restricted to an investigation of the value of training of student pilots and had nothing to do with the employment of gliders as an invasion vehicle.

At present, the Navy is working on two designs for troop or cargo-carrying gliders, according







**LEARNING TO SOAR ON MAN-MADE WIND.** Students at the Lockport school get the preliminary training without risk, gliding on a 45-mile-an-hour breeze from seven-foot propellers driven by Ford V-8 85-horsepower engines at about 1,800 r.p.m. Moored by cables, the glider flies six feet above the ground

to recent testimony given the House Naval Affairs Committee by Commander Ralph S. Barnaby, the Navy's expert on motorless flying and president of the Soaring Society of America. One of these would be capable of water landings. This is most logical inasmuch as the Navy's Marine Corps has long been a specialist in the art of landing troops under fire.

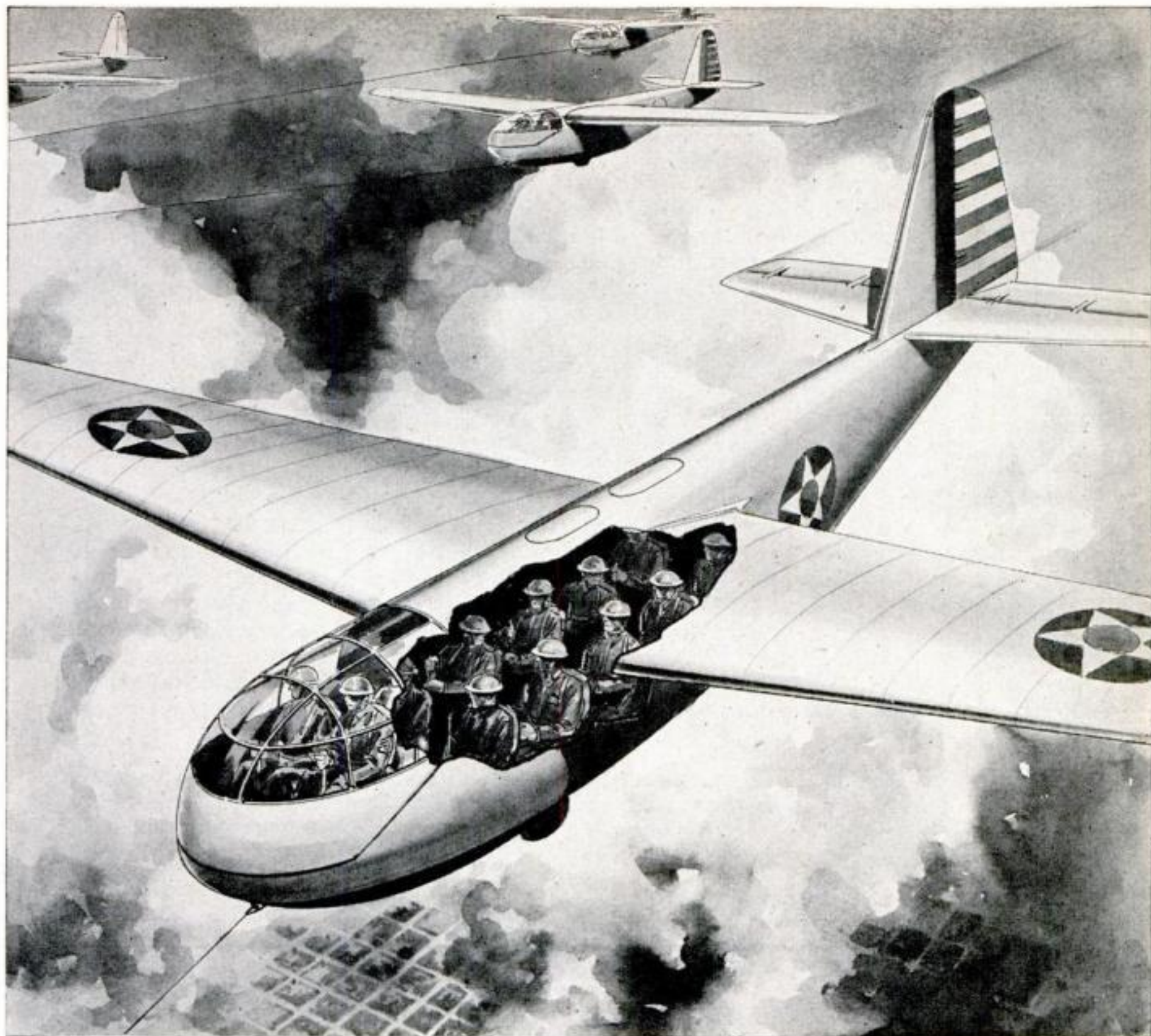
Design and piloting of troop-carrying gliders, which the Army is also working on, present no special problems, either. Such matters are governed mainly by the power and stalling speed of the tow plane. The latter is important because the gliders constitute quite a drag and the tow plane must be flown as slowly as the aerodynamic characteristics of the gliders require. Any airplane pilot can fly motorless craft after a

few hours spent becoming familiar with the "feel" of the glider and its behavior characteristics, which is the usual procedure in making the transition from one type or weight of airplane to another.

The first Army Air Corps order provided that six pilots take a course spread over three weeks at the Warren E. Eaton Motorless Flight Facility at Elmira, N. Y., and that another six do the same at the Frankfort-Lewis School of Soaring, at Lockport, Ill. These courses call for a minimum of 25 hours of soaring and 10 hours of piloting towed gliders. Both schools opened for civilian motorless-flight training this spring.

The first phase consists of tows at a few feet altitude, the towing being supplied by automobile or winch, to become familiar with the craft. Utility gliders of the Frank-





**MOTORLESS AIR TRANSPORT.** This is our artist's conception of a possible use of gliders by the U. S. Army. Sailplane transports, each accommodating 12 soldiers, would be towed in groups of three behind planes, to be released at the proper time and swoop to a landing wherever the men were needed

lin type are used in the early phases because they are rugged enough to stand up under practice landings and take-offs, efficient enough aerodynamically to permit fairly extensive soaring. The pilots graduated to sailplanes in the later phases. Particularly useful in learning to master sailplanes are the two-place, metal-structure Schweizers manufactured in Elmira. About 22 hours of motorless flying was called for with landings by tow car or winch. The balance of the 30 hours was to be spent in single and multiple tows behind powered planes. Altogether they put in 10 to 14 hours per day on both ground and flight work.

It should be remembered in all discussions of motorless flying that there are two types—*gliding*, which is merely sliding downhill in the air after the craft has been cut loose

from tow-car, winch or airplane, and *soaring*, which means gaining altitude by means of vertical currents.

All utilities can soar. Even the heaviest powered airplanes are boosted upward on occasion. For most efficient soaring (or airsailing) we have the sailplane with its high aspect ration wing. The military would be primarily interested, of course, in gliders that can glide long distances after they have been cut loose. The gliding ratio of a glider is about 14 feet in the horizontal plane to one vertically, while sailplanes have a gliding ratio of about 20 to one.

The Army pilots experienced no trouble in making the transition from the high-powered, heavy Air Corps planes to which they were accustomed to the motorless craft. They readily won the Federation Aeronau-



tique International "C License," which is the international license (issued in this country through the Soaring Society acting for the National Aeronautic Association) in recognition of achievement of a basic soaring flight. To qualify a pilot must fly his ship above the point of release for at least five minutes before official observers.

On one solo flight Major Frederick R. Dent, assistant chief of the Materiel Division at Wright Field, and in charge of the research project at Elmira, climbed from point of release at 1,500 feet to 4,000 feet above the valley of the Chemung River facing the Eaton soaring site at Elmira. That he at least among the Army men had been impressed by the potentialities of soaring as an advanced training procedure is evidenced by his statement that "Any power pilot can increase his proficiency by glider flying."

The seriousness with which the Army is taking this research program is indicated by Major Dent's regular position at Wright Field. The other pilots were detached from duty at the Middletown, Pa., and Fairfield, Ohio, Air Corps depots, and other posts.

A multiple-tow take-off is done as fol-

lows: The tow plane is stationed as far down the runway as is necessary to spread the motorless craft behind it. They are placed on the ground in the same position they will occupy in the air. The formation may be tandem, one ship behind the other with a rope lining each unit, or fanned out, with an individual rope between each unit and the tow plane. The length of the rope between the plane and the first glider in the usual V formation of three gliders is 300 to 500 feet. A wire or a  $\frac{3}{8}$ -inch stranded rope is used.

On signal the airplane pilot moves the throttle ahead gradually. As each glider gains flying speed, which of course they reach before the airplane gets up flying speed, it takes off and then is held close to the ground until the airplane is in the air. From then on the gliders keep slightly above the tow plane and in regular step formation, the pilots being careful not to vary much from this position lest the drag be seriously increased or the plane made unmanageable by exerting downward, sideward, or upward pulls. Each glider pilot can release from the tow plane as desired and the tow-plane pilot can cut loose from his charges behind.

In early training, gliders are launched into the air by this motor-driven winch mounted on a trailer. The cable winds up on the drum seen at the right, and is controlled by automatic guides to prevent snarling. Yanked into a rising current of air, the flyer casts off the cable when he gains altitude





Usually there is an automatic release in case an excessive pull is exerted. A Waco F and a Stearman served as the "aerial tugs" at Elmira.

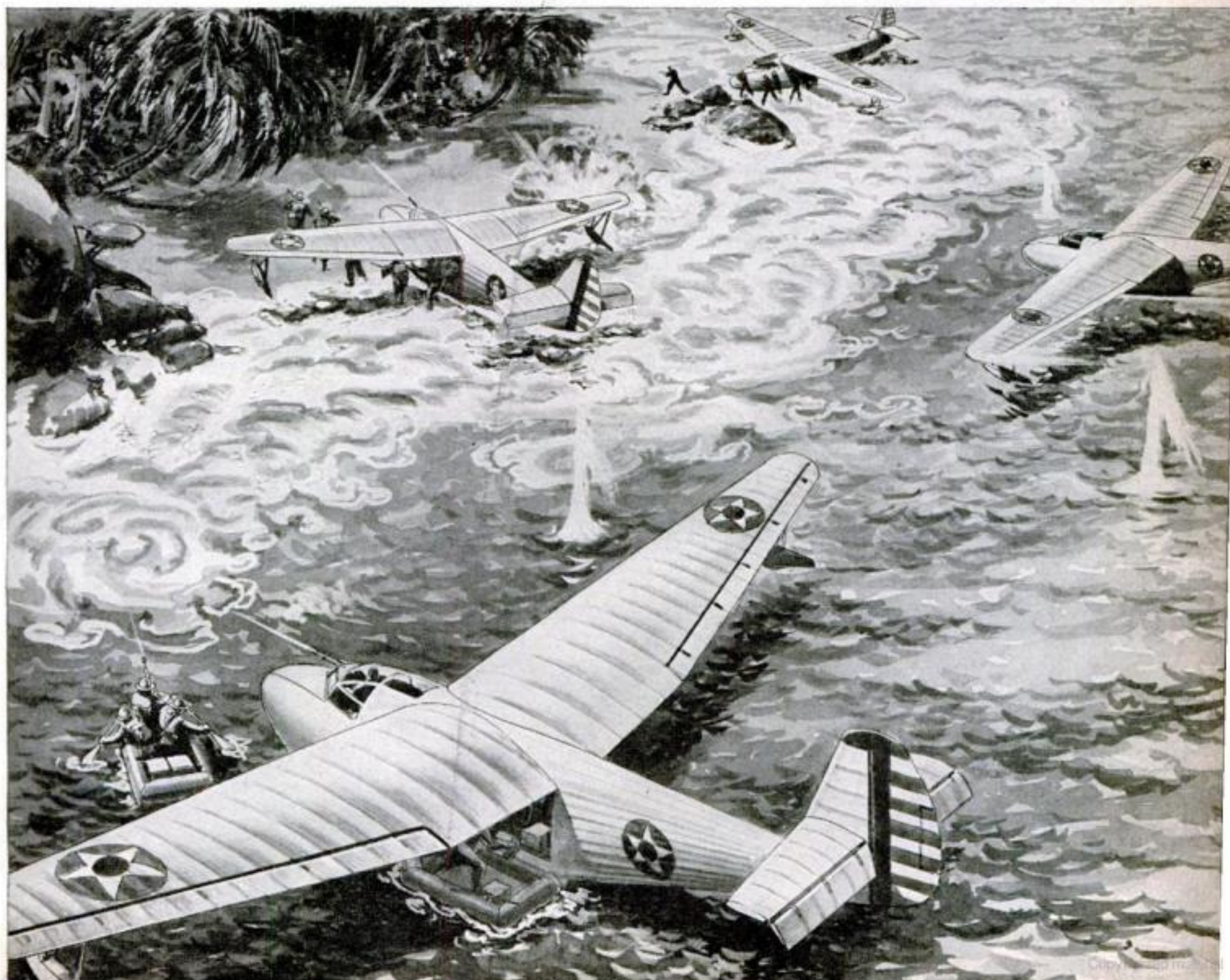
There has been much talk about the great reservoir of glider pilots possessed by Germany, and the idea that we should have a similar pilot backlog. It is a fact that something like 100,000 motorless-flight pilots were trained there but they were glider-trained simply because under the Versailles Treaty Germany was allowed or could afford only the motorless types of craft.

We in this country have a much better backlog. With something like 100,000 civilian airplane pilots (including students) we have a group that could become excellent glider pilots through only short transition periods. And new pilots can be brought along faster than was ever possible in Germany through glider flying alone, because learning to handle the controls of an aircraft, which is the primary phase of flight instruction, can be learned quicker and more positively on our thousands of powered civil aircraft. This country's great fleet of light-planes thus constitutes one of our greatest assets, militarily as well as in a civil sense.

We also have a corps of experienced soaring pilots for instruction and supervision purposes. The 144 glider pilots certified by the CAA as of June 1 seems to constitute a small group. But of that number 58 held commercial certificates, which means that they are authorized to give instruction, and many others of the 144 could be given further training to qualify. In addition there are several hundred persons who have had much experience in all phases of motorless flight over many years who are available to assure plenty of competent leaders to put whatever program might be selected on a sound basis.

Where the Army and Navy will go from here is anybody's guess at the moment. Both services have emphasized strongly that their present work is highly experimental. Perhaps, however, by the time this appears at least a substantially expanded research program will have been launched, or possibly the services will have plunged into the development of fully organized glider transport corps. In any case, the soaring movement stands ready to do its part, and without doubt one of the most radical innovations in our military history is in the making.

Landing marines in troop-carrying gliders is one of the uses foreseen for motorless aircraft by the U. S. Navy. One of the two glider designs being worked out by the Navy is for a craft that can alight on water with troops to establish a beachhead for an expeditionary force, as shown in the artist's drawing below





## Color Meter Beats the Human Eye at Grading Diamonds



Detecting internal flaws in diamonds is easy with the Diamondscope. A special lighting system in the device throws all of the stone into sharp relief

GRADING diamonds by their color, upon which their worth largely depends, has hitherto been a task for highly trained experts. Now it becomes an accurate mechanical process with the introduction of a colorimeter, announced jointly by the Gemological Institute of America and the American Gem Society. Eliminating personal opinion, the device compares diamond tints with 13 shades, or six more than the unaided eye



Another aid for jewelers is the Diamolite, which produces light of uniform quality for grading diamonds by comparing with samples of known color

can distinguish. The invention is expected to be of particular service to small jewelers who cannot afford to hire diamond experts. A jeweler will send a series of diamonds, each of slightly different color, to be graded on master instruments. Then he will use them to grade other diamonds. Additional helps for the jeweler's own shop include a lamp of uniform shade for this purpose, and a magnifier for examining imperfections.

## Scientists Spread Lethal Sandwiches to Test Insecticides



Spreading a sandwich of death: Wafers of potato leaf, spread with a paste containing a minute amount of poison, make up a fatal feast for potato beetles, seen at lunch at right. Note the potato leaves and sandwich disks cut out with a punch

DOSES of poison so small that it would take 2,000,000 of them to fill a teaspoon are used by Cornell University scientists to compare the merits of different insecticides. In one set of tests, the poison is injected directly with a hypodermic needle. Under another plan, bugs are invited to parties where they are served lethal "sandwiches," cut to measure from leaves and filled with the preparation.







## Service Pits Speed Planes at National Airport

**S**ERVICE for planes has gone underground at the new Washington National Airport, to clear the field for arriving and departing airliners. Guide lines lead an incoming pilot to a point where one wheel rests upon a saucer-shaped iron turntable, six feet in diameter, which revolves freely on roller bearings. By braking this wheel, and speeding up the opposite motor, he swings the whole plane around without tire wear or strain on landing gear.

Lifting the covers of four surrounding service pits quickly puts the plane in condition to take to the air again. A communication pit contains a field telephone, over which the pilot reports directly to the airport control tower. Through a pneumatic tube sys-

tem, he receives written flight orders and weather maps. Meanwhile a hose from an air-conditioning pit refreshes the air in the plane cabin. A third pit replenishes oil and fuel; and a fourth recharges the plane's battery, if necessary. It also avoids draining the craft's battery in starting the motors; instead, a pole carrying an electric cable is applied to an electrode of the engine's self-starter.

Other innovations appear in the \$16,000,-000 skyway terminal just placed in service. Its nerve center, the air-conditioned control tower, employs glass windows slanting inward at the bottom at curious angles to eliminate unwanted reflections. Five-foot wiper blades, electrically driven, assure vis-

Control-tower man watches an incoming plane taxi in to the service pits. Note slanting glass of control-tower windows and five-foot electric wipers

With one wheel locked on a saucerlike turntable, a plane can be turned easily by gunning the motor on the opposite side, saving strain and tire wear







## QUICK SERVICE FOR PLANES AT THE NATION'S CAPITAL

Illustrated on this page are some of the ingenious safety, control, and service features that make the new National Airport at Washington, D.C., one of the most modern airway terminals in the world. The drawing at the left shows how the huge flying field looks from an incoming or outgoing plane. Below is pictured the system of service pits that makes it possible to care for the planes without cluttering the apron with trucks.

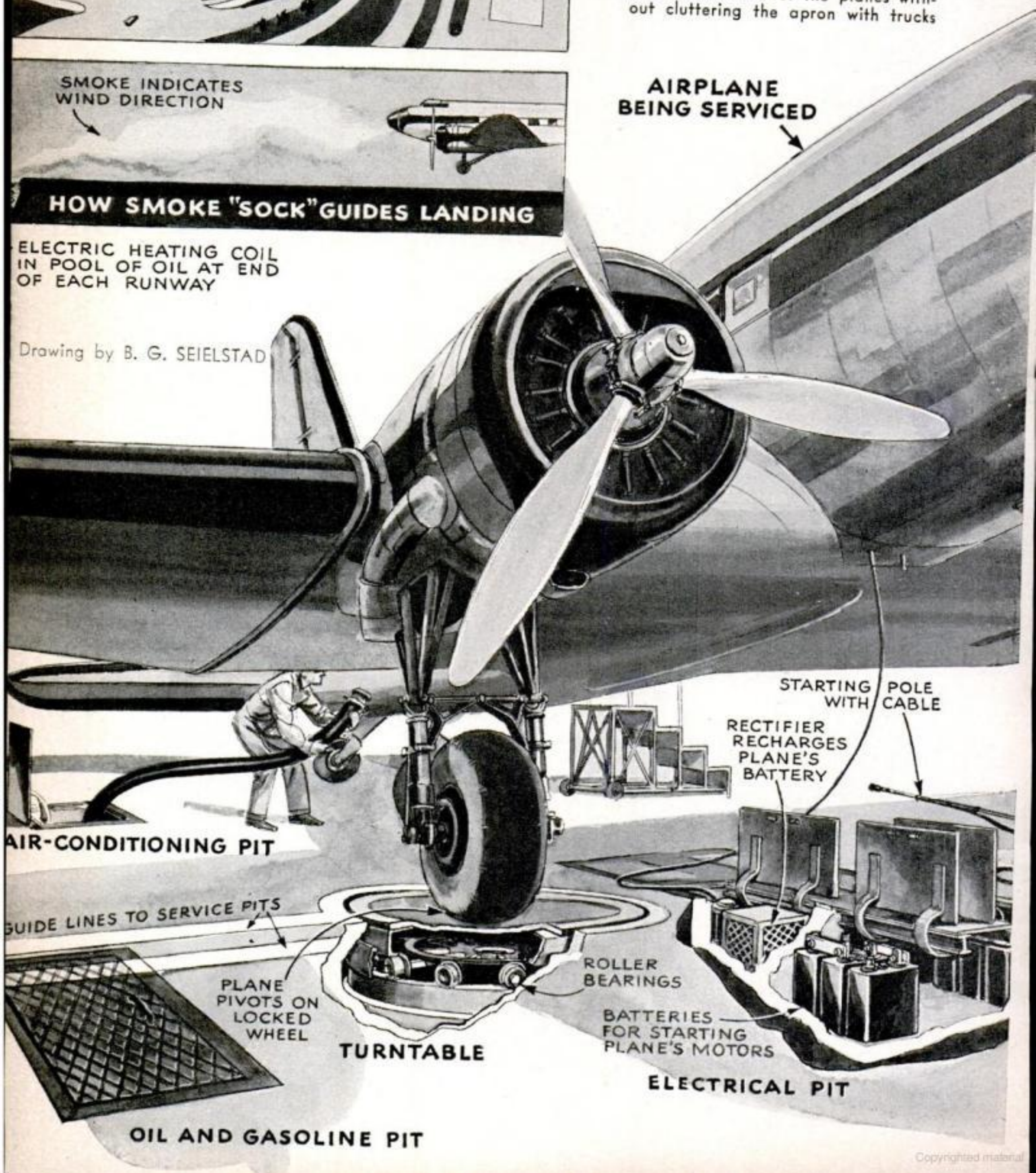


## HOW SMOKE "SOCK" GUIDES LANDING

ELECTRIC HEATING COIL IN POOL OF OIL AT END OF EACH RUNWAY

Drawing by B. G. SEIELSTAD

## AIRPLANE BEING SERVICED







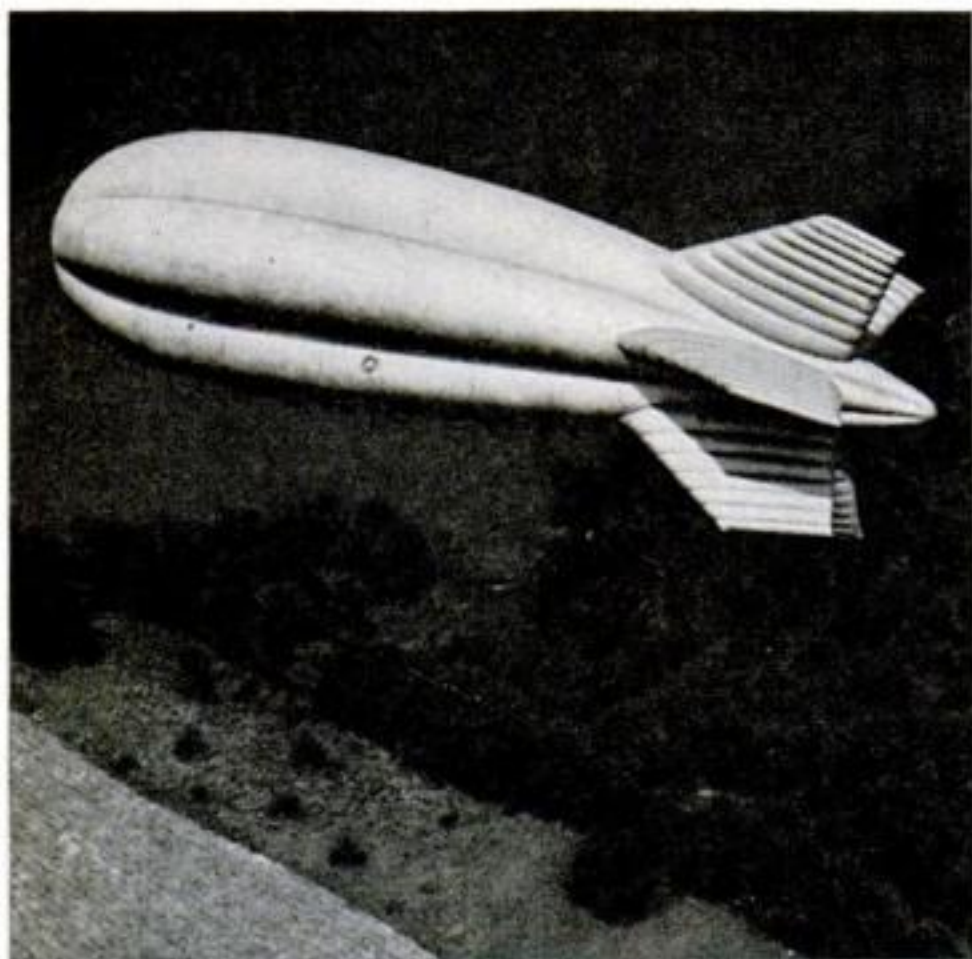
**COMMUNICATION PIT**

**UNDERGROUND PITS  
KEEP AIRPORT CLEAR  
OF SERVICING VEHICLES**

ibility in wet weather. When the sun beats down, its heat—a burden to most control-tower operators—is absorbed by special green-tinted glass, which also prevents glare. Radio equipment in the tower provides for two-way communication with planes, while an automatic device makes a record of every conversation between the tower operator and pilots, indelibly fixing the responsibility for possible incorrect or disregarded instructions.

As a pilot approaches the field for a night landing, he sees the runway he is to use outlined by white lights set flush with the surface at intervals of 200 feet, while a large arrow in green neon lights indicates the direction. After landing, he follows a string of blue lights to his position on the apron.





THE STRATO-SENTINEL, biggest barrage balloon being built for the U. S. Army, outperforms any other in the world. Holding 68,000 cubic feet of helium, it can rise to 15,000 feet—nearly three miles—to make bombing planes keep their distance

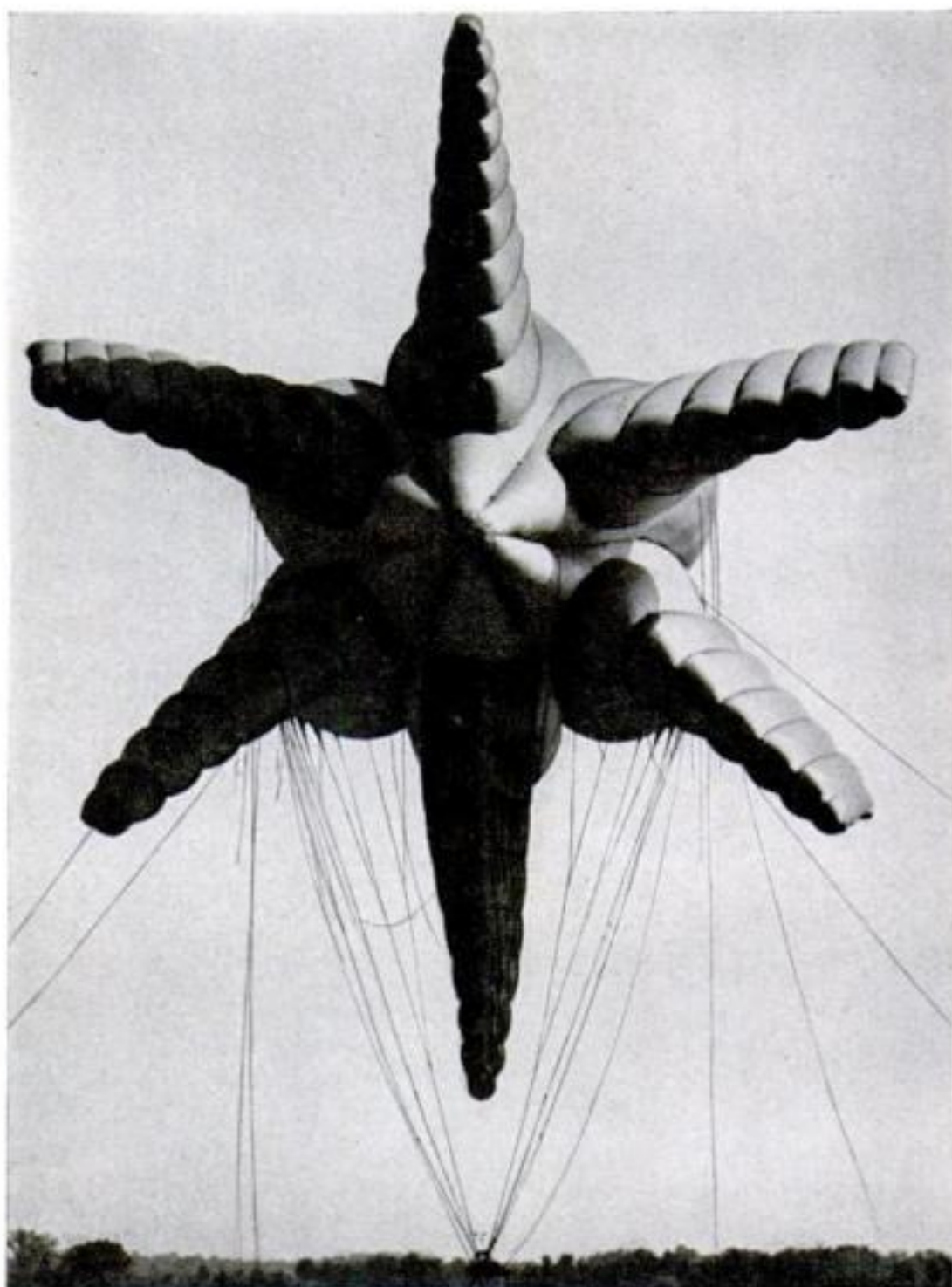


UP SHE GOES! A 25,000-cubic-foot bag takes the air at the end of its steel tether. A winch of secret design, outside the picture, speeds raising and lowering. The lines joining below the balloon give it its nickname of "spider"

## FLEET OF *Flying Spiders* READYED FOR ARMY

A FLEET of 6,000 barrage balloons, nicknamed "flying spiders" by the men and women who make them, is being turned out for the U. S. Army at Goodyear and United States Rubber plants. They range in size from little 1,500-cubic-foot bags designed to be towed by trucks at altitudes of 1,500 to 2,000 feet to huge Strato-Sentinels of 68,000 cubic feet capacity that will rise to altitudes of 15,000 feet. Some of the smaller ones are designed to be towed above ships. They will have steel mooring cables to entangle any planes that try to fly beneath them.

An aerial starfish: stern view of a Strato-Sentinel's stabilizing fins



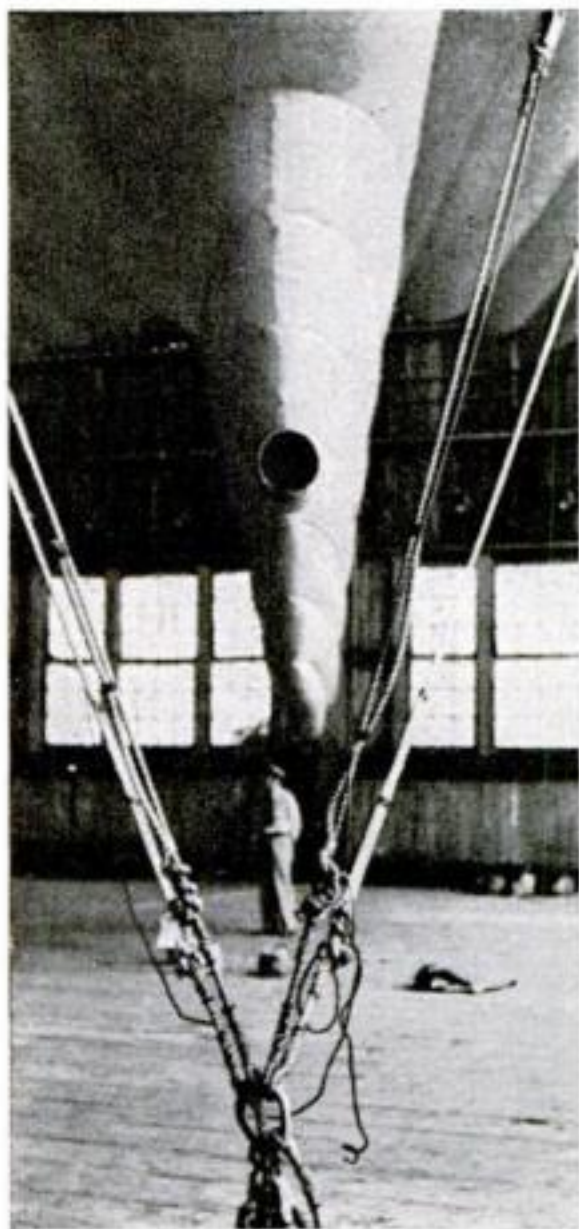




**FOR TOWING BEHIND SHIPS** to keep dive bombers away, this 5,500-cubic-foot balloon rises 4,000 feet. In the background is a 30,000-cubic-foot bag which, like the 25,000-footer in the photograph at the left, is used at 7,000 feet



**SMALLEST OF ALL** is this type of barrage balloon. Holding from 1,500 to 2,000 cubic feet of gas, it can be dragged behind a truck at an elevation up to 2,000 feet. Women excel at cutting and sewing rubberized fabric for balloons



**BEDDING DOWN** a 25,000-cubic-foot balloon in a field, ready for instant use. It is anchored to eyelets set in the ground. The large balloons are of lobed construction, and each lobe has a stabilizing fin. The bottom fin, which collapses when the bag snuggles down to the ground, is a separate ballonet with a hole like the one shown at the left to let air in or out as the helium gas expands or contracts





## Helmet and Field Hat Are Combined in Army's New Infantry Headgear

"POT" HELMETS are being tried out to replace the familiar "basin" type worn by U. S. infantrymen in World War 1. Scientific design in the new style gives maximum protection, covering about 80 per cent more of the head than the 1917 helmet did, while leaving just enough room for the pack and for rifle sighting. With its outer steel shell removed, the two-in-one helmet makes a cool and comfortable field hat. Its shape stems from research delving back into the earliest types, but one of the best tips came from a maker of plastic football helmets, who had devised a detachable head-band available in sizes to fit any soldier.



OEM Defense  
Photos

Corporal French L. Vineyard, of the 12th U. S. Infantry, is seen at the left wearing the new "pot" helmet. With the steel shell removed, as at the right, the liner makes a cool field hat

Designed to give maximum protection, the helmet still does not interfere with sighting a rifle or wearing a pack. Men who have to use earphones may find the overhang at the side a little trying





# Housing a Hurricane

## SOUNDPROOF LABORATORY BUILT TO TEST AIRPLANE MOTORS

By WALTER BREHM

**N**OISES too loud for their full blast to be heard will fill soundproof rooms, when aviation engines of up to 2,000 horsepower go into action, in the University of Kentucky's new motor and propeller testing laboratory at Lexington. Acoustic experts rate the combined roar of such a power plant and the shriek of its propeller at upwards of 150 decibels, or sound units. Human ears respond only to about 120 decibels; above that crescendo of pandemonium, they distinguish nothing louder.

Sounds of such intensity, 1,000,000 times greater than those of a busy street corner, not only are nerve-racking but actually dangerous to health. A man without ear plugs, entering a room where an air motor is run-

ning under full throttle and heavy load, would suffer temporary deafness at least. Even with ears protected, many persons would be affected with nausea.

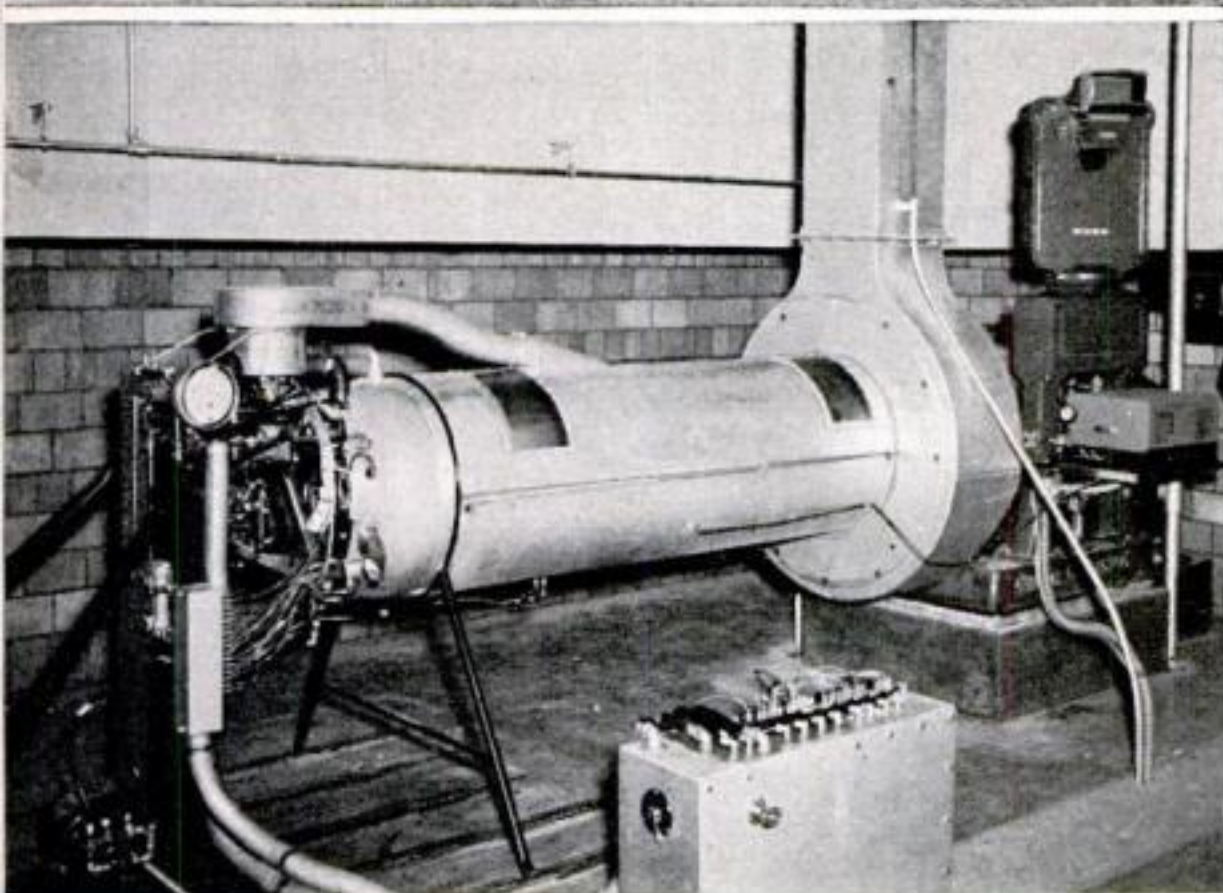
For this reason, workers go into the five motor test rooms, and the propeller-testing section at the end of the laboratory, only to make preliminary adjustments. Then, closing soundproof doors, they withdraw to a central observation room from which the ignition, throttle, and spark advance of each motor may be operated by remote control.

While engines pit their strength against measuring devices called dynamometers—in principle nothing more than giant brakes—observers look on through thick windows and read dials and gauges. Manometers give pressure readings, electric thermometers show the temperature at 28 different points on an engine under test, a tachometer

indicates revolutions per minute, and a gasoline meter checks fuel consumption, giving a thorough picture of the motor's performance under widely variable operating conditions. Lest poisonous exhaust gas seep into the observation gallery, its ventilating system maintains a slightly higher air pressure than in the surrounding test rooms.

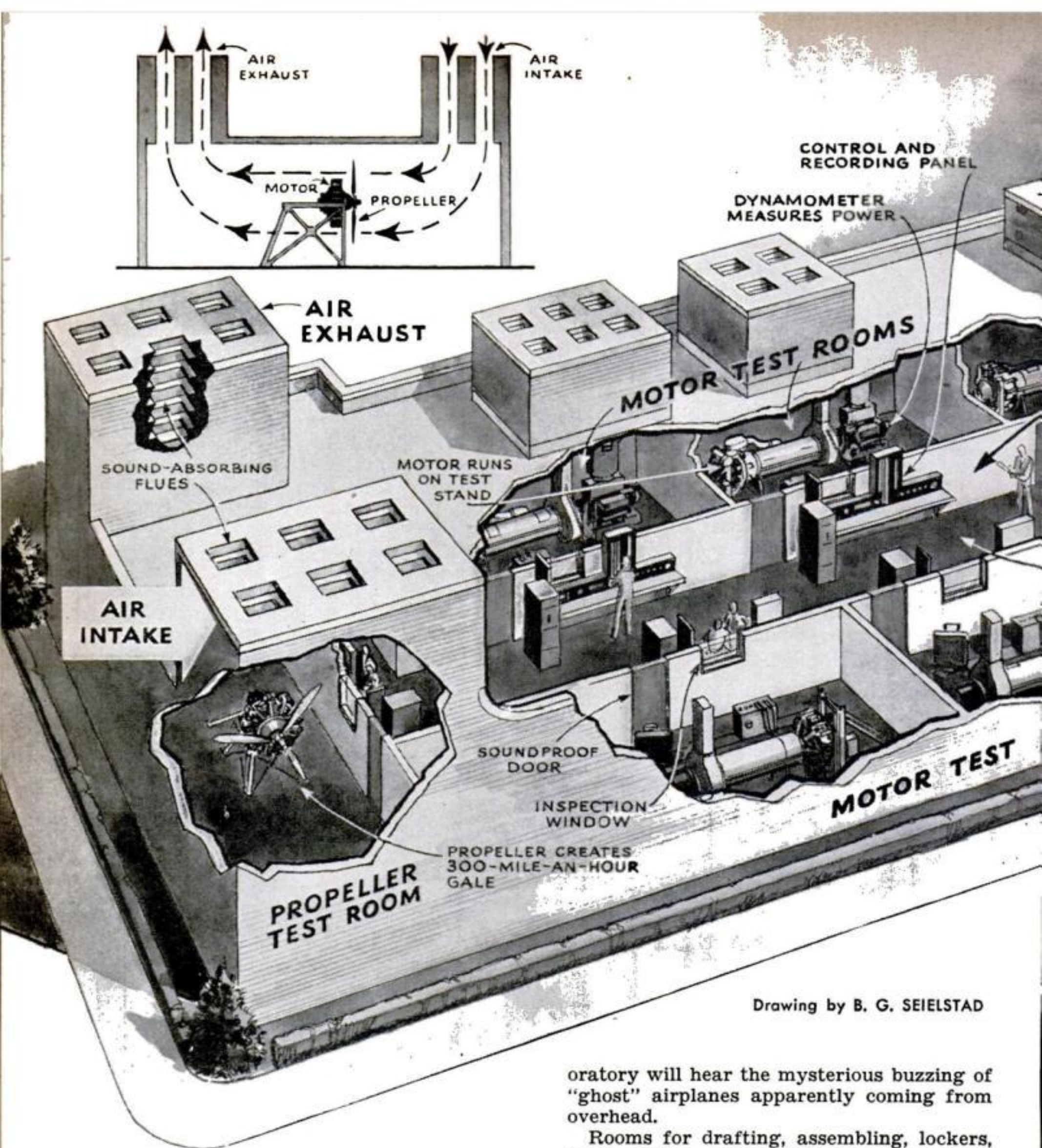
Through the propeller-testing section, during a trial, rushes an artificial hurricane of 300-mile-an-hour speed. Drawing in and discharging a volume of 2,500,000 cubic feet of air a minute, while straining out noises that would shatter the academic calm of the campus and bedevil residents in the neighborhood, presented a major problem. Sound engineers solved it in a remarkable way.

Incoming and outgoing air streams both pass through multiple flues in towers atop the building. Sawtooth bricks of sound-absorbing material line the flues. Angles of the brick ends have been so cleverly calculated that a sound wave echoing from one will be sure to strike another, and another, until its force dies



An experimental engine under test at the Wenner-Gren Aeronautical Laboratory. The upper photograph shows the exterior of the elaborately soundproofed building at the University of Kentucky





Drawing by B. G. SEIELSTAD

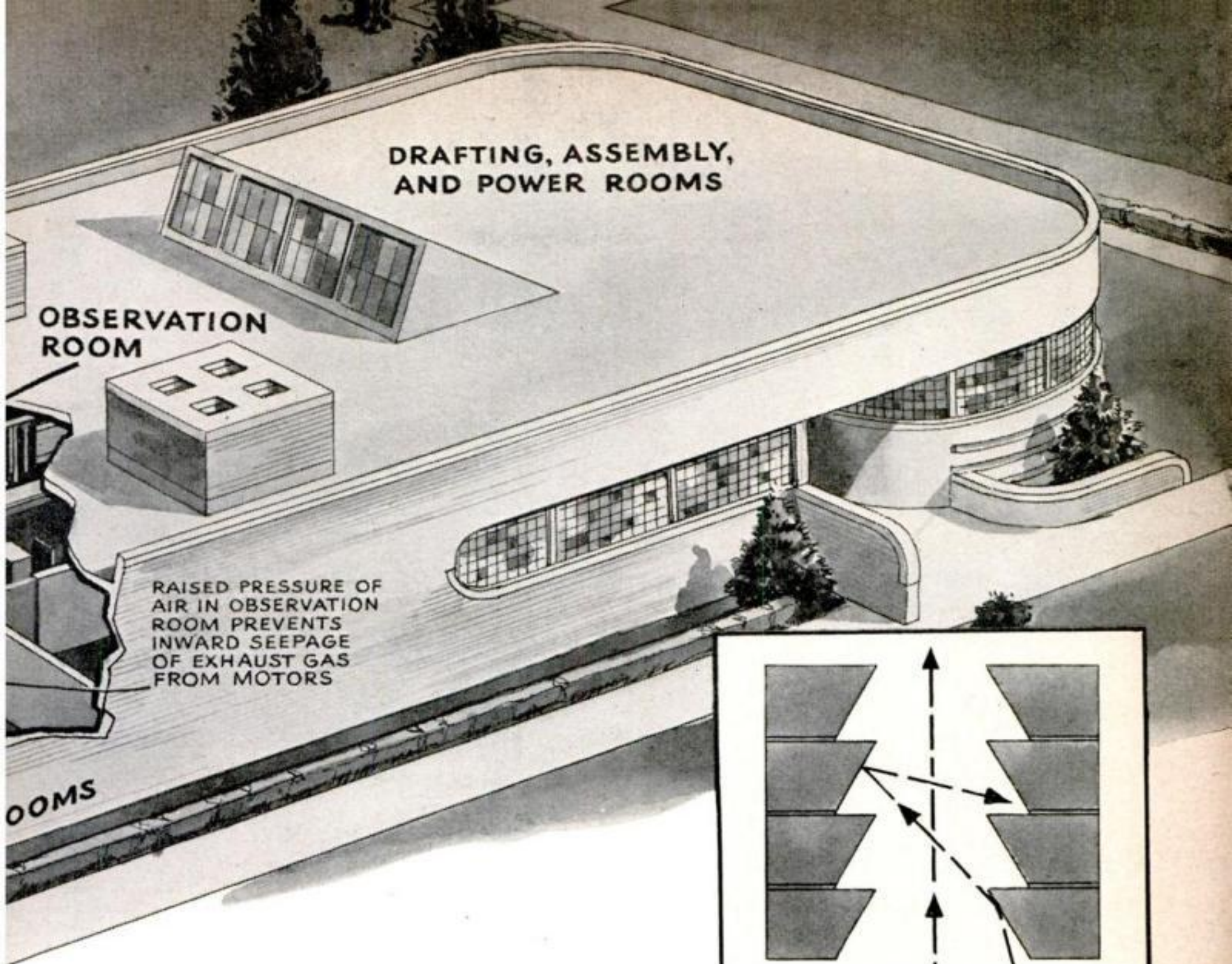
out within the flue. The action might be compared to that of a billiard ball losing some of its momentum each time it caroms off a rail of the table, and finally coming to rest.

Only sound waves that enter the flues in an absolutely vertical direction can escape, and these travel upward to great altitudes and dissipate themselves in the sky. Once in a while, it is true, peculiar atmospheric conditions may give the upper air the sound-reflecting quality of a whispering gallery. Then people as far as 12 miles from the lab-

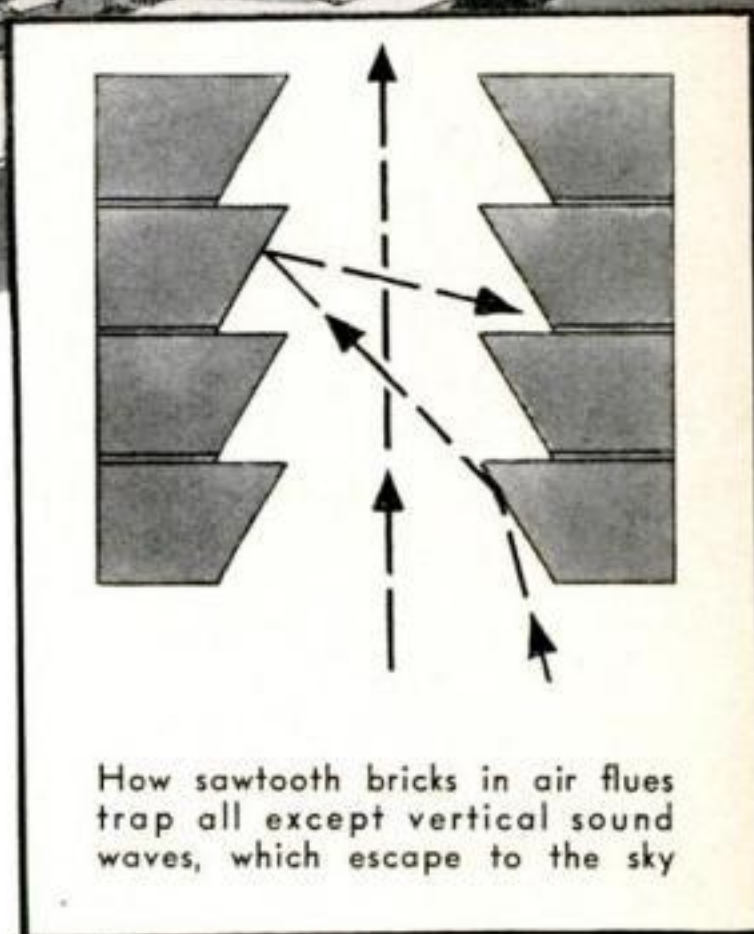
oratory will hear the mysterious buzzing of "ghost" airplanes apparently coming from overhead.

Rooms for drafting, assembling, lockers, tools, and a self-contained power plant complete the ultramodern laboratory. Huge underground storage tanks outside the building feed fuel to the greedy motors—a 1,000-horsepower motor consumes 100 gallons of gasoline in an hour. City water, of all things, supplies the needed pressure. The gasoline floats on top of water admitted through mains to the bottom of the tanks, since it is lighter, and is thus forced into a fuel pipeline system running through the laboratory. An automatic regulating device controls the flow of water from the mains, with the result that fuel is fed from the tanks at uniform pressure.





## Noise Filters Built into Flues Muffle Din of 2,000-Horsepower Plane Engines



The establishment, it has been announced, will take a direct part in national defense by serving as a power-plant branch for the U. S. Army Air Corps' program of training and research. Hand-picked engineers will go there to receive a 12-weeks course in laboratory technique and methods.

In addition to the testing and studying of actual production-model airplane engines, the laboratory will be used for conducting researches with experimental one-cylinder engines to help solve new problems in combustion, lubrication, cooling, and mechanism. With the great increase in plane production, the importance of research is obvious.

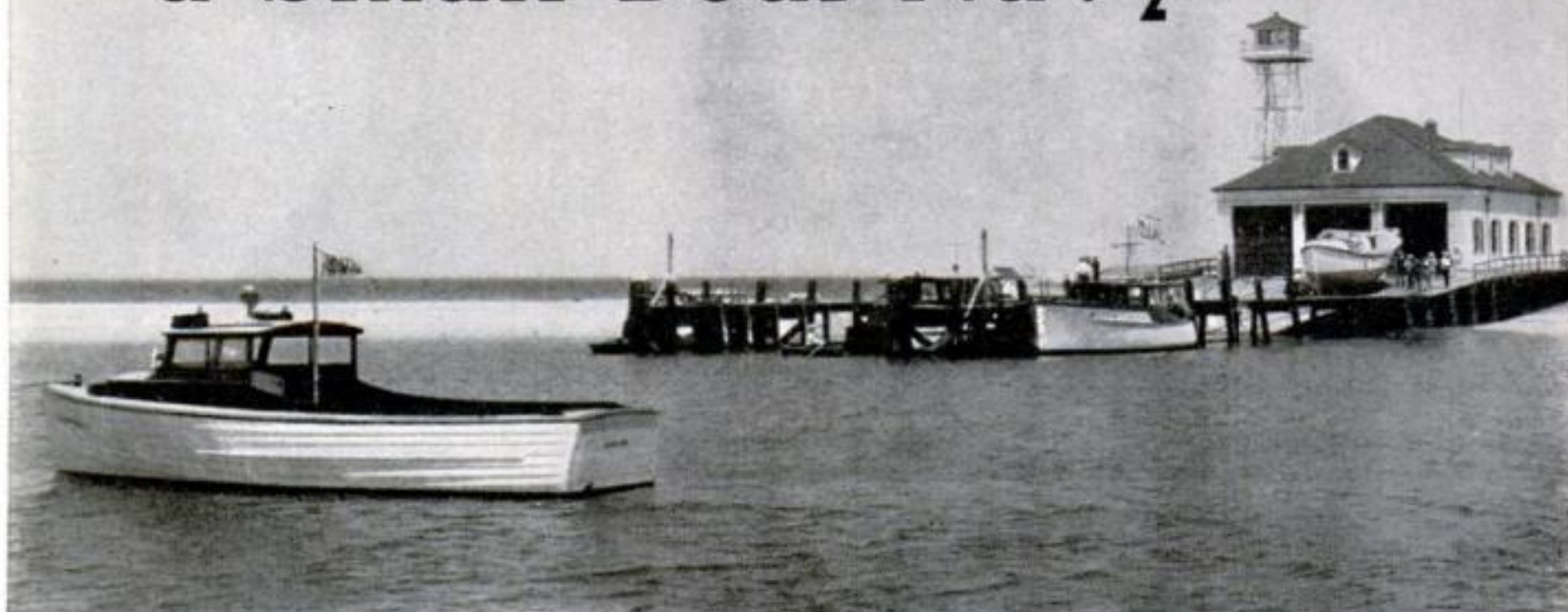
Directing the work of the laboratory is A. J. Meyer, who was superintendent of the Fokker Aircraft Company at Amsterdam, Holland, 20 years ago and more recently has

served as research engineer for several leading American aeronautical corporations. He holds more than 125 patents on engine design and construction.

Called the Wenner-Gren Aeronautical Laboratory, the testing plant takes its name from the noted Swedish industrialist whose grants made it possible. It is not the first time that Axel L. Wenner-Gren has made news. At the outset of the war, he saved 350 lives when he brought his yacht, the *Southern Cross*, to the rescue of passengers aboard the sinking British liner *Athenia*. More recently, he sponsored an expedition that discovered lost cities of the Incas in uncharted wilds of Peru. Now, in the University of Kentucky laboratory, he has found a way to benefit science and the armed forces of democracy.



# Coast Guard Mobilizes a Small-Boat Navy



Coast Guard Station at Eaton's Neck, L. I., one of many where yachtsmen are doing Coast Guard duty

## America's Yachting and Fishing Fleets, Organized into a Valuable Auxiliary, Help Patrol the Reaches of Our 40,000-Mile Coast Line

By HICKMAN POWELL

AMERICA'S booming luxury sport of motorboating and its \$100,000,000-a-year small-boat industry find themselves at the very heart of one of the most important expansions in the national defense effort. The United States Coast Guard, the military service which up to now has carried the brunt of this country's direct contacts with the new world war, has set out to build up a reserve force by drawing upon the skills of the amateur yachtsmen and fishing-boat skippers of our coasts and inland waterways. The vast flotilla of motor cruisers in the yacht basins of tidewater, which has increased so rapidly during the last decade, now becomes a reservoir of picket boats for keeping watch over the 40,000 miles of shore line which are the ramparts of the United States.

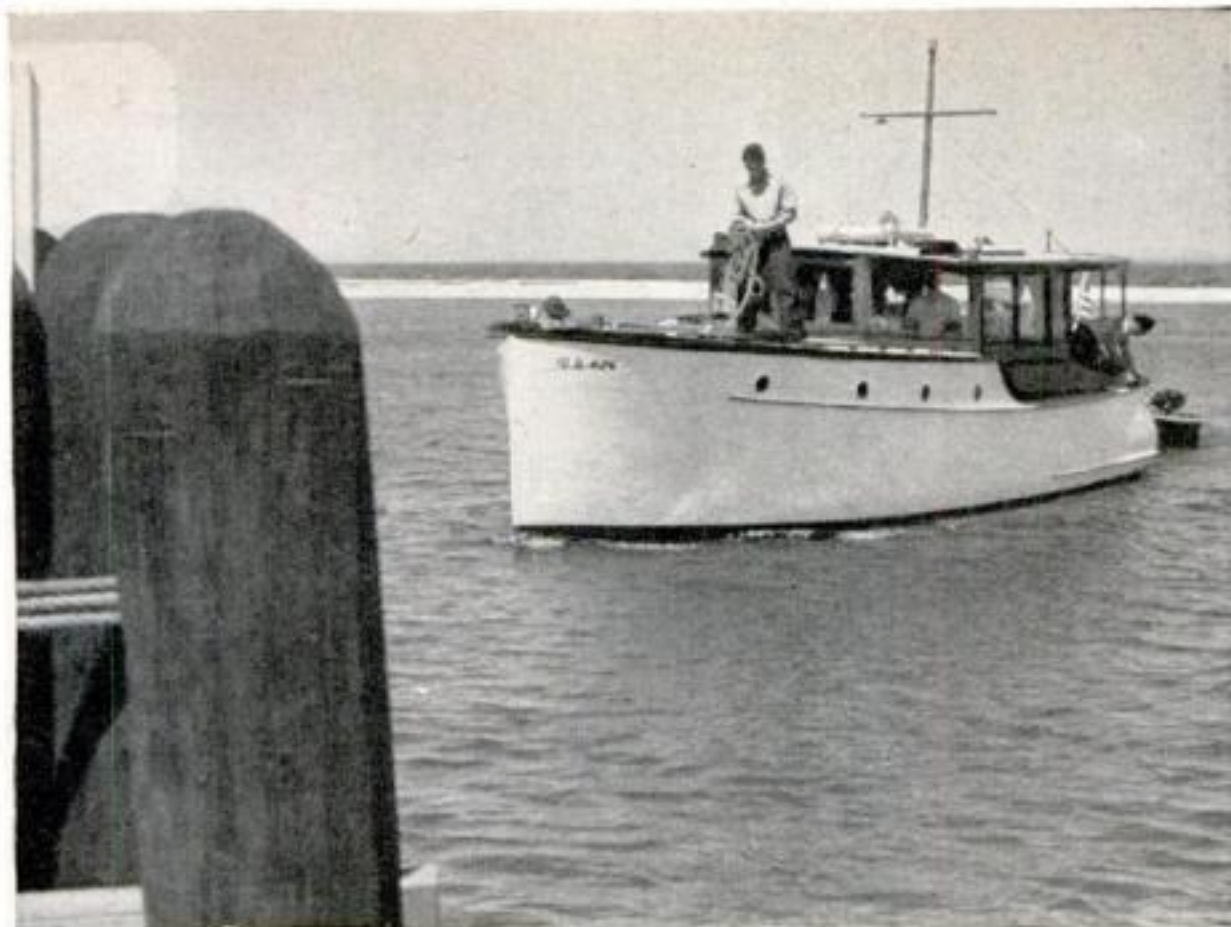
The navigation of big ships at sea and the handling of small vessels in coastal waters are two different skills. Officers of the merchant marine are being grabbed up rapidly by the Navy, which within a few years will have the problem of manning a two-ocean fleet. Meanwhile the Coast Guard is concentrating on its friends, the yachts-

men, whose knowledge of seamanship, navigation, and gas engines, plus familiarity with local waters and boatmen, makes a national-defense asset immediately convertible to a useful purpose. These men would be green-horns aboard a battle-wagon, but along the line of their own hobby, many of them are extremely good. And so are their boats.

Ever since the evacuation of the British army from Dunkirk, accomplished largely by England's fishing and yachting fleets, the value of small boats in military operations has needed little sales talk. Professional naval men, of course, have recognized it all along. In every year's maneuvers in the Caribbean, the fleet has taken along a hundred of the Coast Guard's surfmen, whose skill on the beaches is of tremendous importance for such operations as the landing of marines.

Such needs spring up in unexpected places. Right now, the most immediate value of the Coast Guard's new reserve fleet is not on the seacoast at all, but in the upland reaches of the Tennessee River. Building the dams of the Tennessee Valley Authority created great inland lakes, upon which immediately sprang up large fleets of motorboats. The Coast Guard did not have the equipment to police these waters, though obviously the presence of a swarm of unsupervised craft presented grave danger of sabotage against electric power. Local reserves, familiar with local boats and boatmen, were able to take over guard duty more efficiently than any Coast Guard reg-





The Myargo, a 36-foot motor cruiser owned by Willard K. Denton, the executive vice-president of the Metropolitan Savings Bank of New York City, reports for a month's tour of active duty, complete with its crew

After being sworn in at the Eaton's Neck Station, Denton, who holds the temporary rank of Chief Boatswain's Mate in the Coast Guard Reserve during his month's tour of duty, and the crew of the Myargo get their orders

Back on the boat, the Coast Guard ensign and commission pennant are hoisted to show that the Myargo is now enrolled as a Coast Guard vessel. The ensign and pennant are the mark of authority of the Coast Guard



ulars imported for the purpose from salt water.

This country has 300,000 power boats in Federal waters, and they have been increasing at the rate of more than 35,000 a year. Those figures do not include the boats on intrastate lakes, or the 150,000 outboard motors which go into service each year on inland waters.

The job of mobilizing a small-boat navy, selected from the best of these 300,000 units, was started by the Coast Guard two years ago, under authority of the Coast Guard Reserve Act of 1939. That was a very innocuous law, specifically nonmilitary in purpose, which provided that yachts and commercial fishing boats might be organized into flotillas of "reserves" for the purpose of study of seamanship and the promotion of safety. It was provided that the Coast Guard might borrow the reserve boats for rescue missions and the patrolling of regattas. There were repeated announcements that all this had nothing



to do with national defense plans, but the yachtsmen knew better. They nodded, and joined up.

By the end of the yachting season of 1940 the Coast Guard Reserve numbered 3,000 members, organized in 150 flotillas with 2,700 boats. The number might have been much larger, but the officers in charge preferred that the organization grow slowly and tightly, with high standards.

Then they were ready for serious business, made possible by the Coast Guard Reserve Act of 1941, passed last February. This law abolished the old "reserve" and set up an actual military reserve, under which officers and men have been commissioned and enlisted, and sent to sea for active duty.

In place of the old Reserve, the new law created the Coast Guard Auxiliary, roughly the equivalent of the 1940 Reserve, but a more serious matter. Under the new law any of the thirteen District Commanders of the Coast Guard may call on Auxiliary boats that have been voluntarily offered for temporary active service, for any purpose he may deem desirable, enlisting the owner and his crew as temporary members of the reserve on active duty, under command of a regular Coast Guard officer.

The yachtsmen went for it like flies for molasses. Under this plan the owner of a motor cruiser could sign on a crew of like-minded friends, then enlist the boat and crew for active duty. The Government pays no rent for such a boat, but it pays all maintenance and running expenses and as long as the boat remains in service the Coast Guard provides uniforms and regular enlisted men's pay to the crew. If in service for three months or more, the skipper may be commissioned as an ensign or lieutenant (junior grade).

These temporary enlistments mean that a large number of yachtsmen are receiving invaluable training, this summer, in their own boats, in the duties of patrol and law enforcement which they might be called upon to assume if actual war should call off much of the regular Coast Guard.

The program for this summer called for the immediate commissioning in the Reserve of 100 commissioned officers and 126 warrant officers for sea duty on regular cutters, and for the use of 270 boats from the Auxiliary with six enlisted men each. This would provide 1,620 enlisted men for reserve service at one time, but because the enlistments are temporary, it is providing training for a much larger number.

While 270 boats does not seem like many in wartime terms of thought, they are a large addition to the Coast Guard's peacetime strength of 267 cutters (72 feet or more) and 199 picket boats. These boats

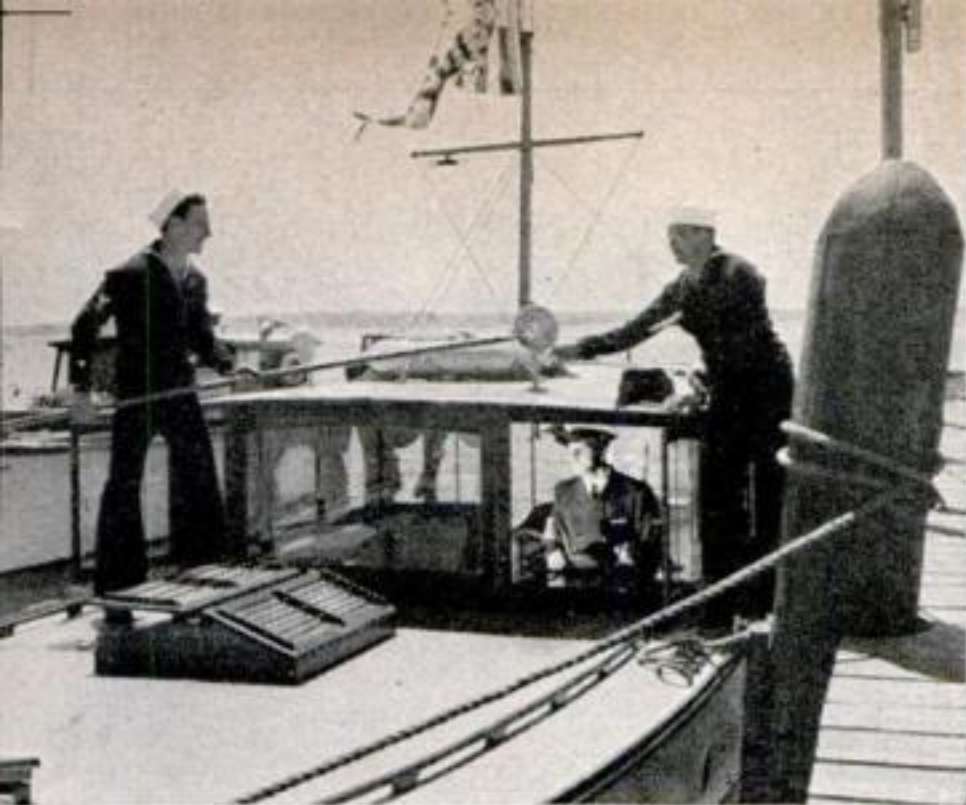
are predominantly in a class with the smaller picket boats, ranging from 30 to 40 feet. This country had many larger yachts, of high-speed, sea-going caliber, but most of these have been bought up by the British or the United States Navy. By last spring nearly 100 of America's most luxurious yachts had gone into service with the British.

The small boats are being used mainly for harbor work, releasing the larger, tougher Coast Guard vessels for duty outside. Inevitably, if war should come, the routine work of patrol will have to be done by smaller vessels than in the past, for the larger units will be called for combatant duty. Already, under the lend-lease law, President Roosevelt has transferred to the British the Coast Guard's ten 250-foot cutters of the "lake" class—stout, fast vessels which had been heavily armed and otherwise prepared for warfare. That was a hard blow to the Coast Guardsmen, who prized these little ships highly, and hardly expect to see their like again. Worse, their seven 327-foot cutters have been taken over by the Navy, as well as some smaller craft.

The Coast Guard, with a military establishment rapidly increasing through enlistments toward a goal of 25,000 men, is an extremely important adjunct of American defense. It is a part of the Treasury Department, but automatically upon declaration of war, or by order of the President in an emergency, it becomes part of the Navy. Its network of radio, telephone, and cable communications covering the whole coast line, its hundreds of surfboat and patrol stations, its ten air bases, its boat-building yards, its lighthouses and lightships, all are of immense importance for defense; but functionally they are geared more for peace than for war. The Coast Guard's 55 airplanes, for instance, are of almost no military significance, except perhaps as reconnaissance units; but its 65 aviators are all competent military flyers, trained in the Navy's Pensacola school. During the World War more than a third of the Coast Guard's line officers were put in command of combat ships; and in the 1940's, when the ships are ready, men of equal caliber will be ready to take them over.

A yachtsman who is on active duty with the Coast Guard is of course exempt from other military service, but it would be a great mistake for anybody to sign up with the idea the service is anything like the home guard. The Coast Guard lost a bigger percentage of its officers and men in combat in the World War than did either the Army or Navy. The service, going back to the Revenue Marine founded by Alexander Hamilton, has as fine a tradition as any military outfit in the country.





Ready to put to sea. Denton's crew consists of Frank Kolasch, who takes care of the boat ordinarily, and Charles S. Lott, a construction engineer



Hailing a motorboat. Part of the Coast Guard duties being performed by the Auxiliary boats is boarding vessels to check up on their equipment

The Myargo pulls alongside and Denton steps aboard. It's easy in a calm, but in rough weather, putting one boat alongside another is a ticklish business

Looking over the life preservers to see that they meet Government specifications. Every motorboat must have at least one aboard for each passenger



During the present emergency, while the Army and Navy have concentrated on building up their striking power, the Coast Guard has been the handy man of national policy. When President Roosevelt decided to seize the German, Italian, and Danish ships in American harbors, the Coast Guard did the job. Every major American harbor is today under the command of a Coast Guard captain of the port, who rules all anchorage and movement of ships, keeps rigid control over all loading of explosives, guards against sabotage. For nearly a year before the President declared an American protectorate over Greenland last spring, Coast Guard cutters had patrolled the Greenland coasts, cultivated the friendship of the local population, watched for signs of Nazi activity. At Lisbon, America's one remaining point of direct contact with



Europe, a Coast Guard cutter stands by to represent the flag.

Even if all the job he gets is running a patrol boat in his home-town harbor, the man skilled with small boats will find no better line of service than the Coast Guard. Should war come there is little likelihood that our coast line will remain as immune as it was in the last war, and even then it was not unscarred. One maritime hero of the last fray was the skipper of the Diamond Shoals Lightship, who was spending his life anchored off Cape Hatteras. Observing a German submarine operating in the vicinity, he sent out a radio warning to near-by ships. Cheated of its prey, the submarine turned around and sank the lightship. The chance to be a hero is like lightning. You never can tell where it will strike.





This plane can't spin or nose over. The pilot fingers the wheel and throttle, all that's required to run it

## You Steer This Plane Like an Auto —And Brake It the Same Way

THE SKYFARER, a two-place plane which it is estimated the average person can learn to fly in an hour or so, has been developed by the General Aircraft Corp., of South Lowell, Mass. No coördination is required between hands and feet, two fixed fins replacing the rudder. Only a hand throttle and wheel are used to operate it, the single foot control being a brake. Wing flaps steepen its glide so it can make short landings, and hydraulic brakes on the rear wheels stop it quickly. It is the second plane ever built to be certified by the Government as "characteristically incapable of spinning."

## Freezing Keeps Coffee Fresh, Sealing the Oils from the Air

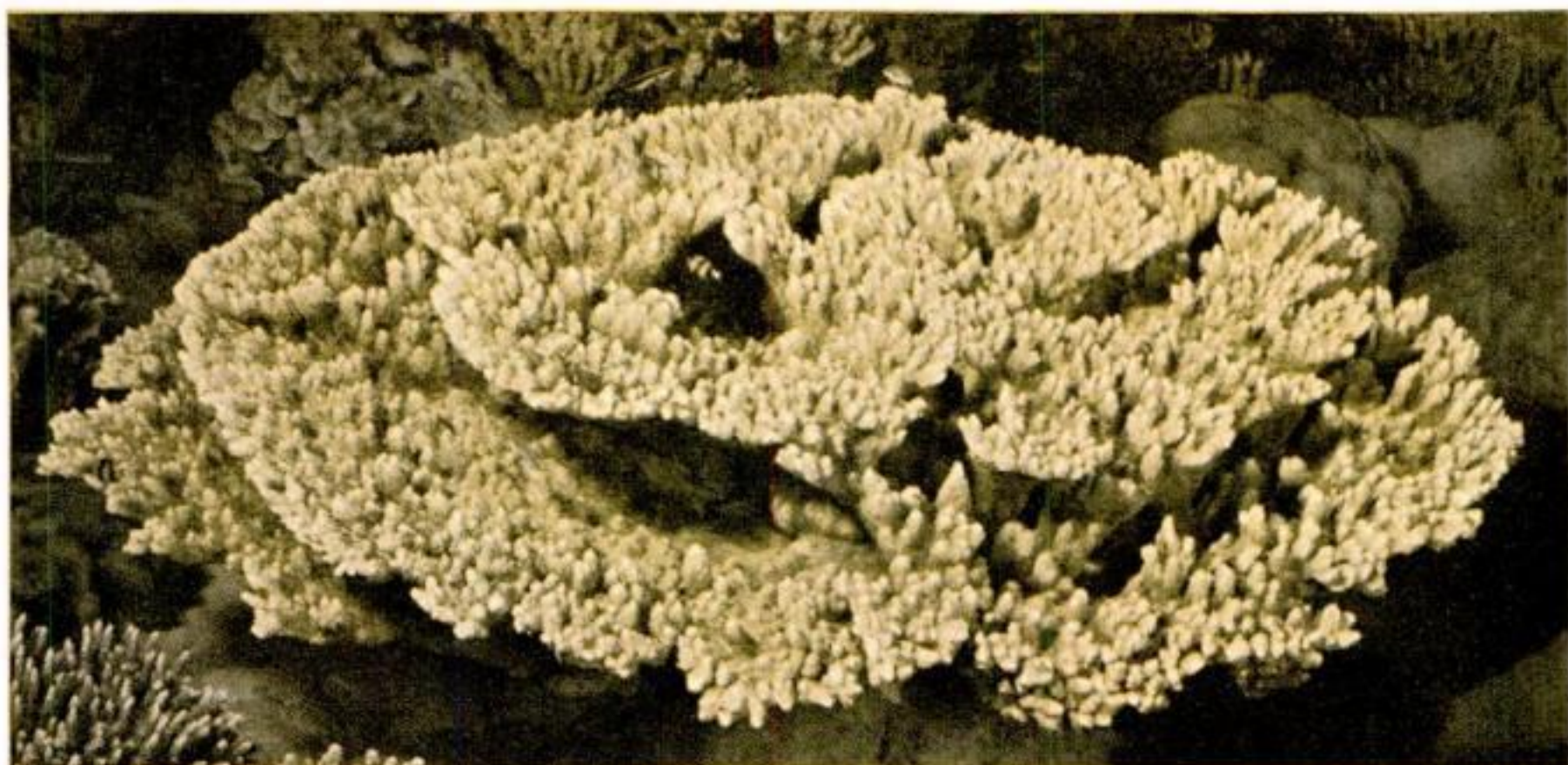
FREEZING ground coffee at—15 degrees Fahrenheit seals the oils from the air and keeps them from turning rancid. After two hours at this temperature, the coffee is stored in a room kept at zero. The distributor recommends that the housewife keep it in her refrigerator to preserve its quality.



## Flashlight Barrel Is Its Battery

THE BATTERY of a flashlight now on the market serves also as its barrel. When the battery wears out, you screw another into the Tenite lighting assembly. Two models are available, one nine inches long for heavy duty and the other 6½ inches long. Both are of the prefocused type.





A 900-pound golden tan spiral Acropore coral is the center of the new museum display of ocean life

## Lifelike Underwater Exhibit Shows 900-Pound Coral

**S**PARKLING with the rainbow hues of tropical fish and multi-colored corals, a lifelike exhibit of a pearl diver on the ocean floor has just been completed at the American Museum of Natural History under the direction of Dr. Roy Waldo Miner. The setting chosen is a coral gorge on the sea floor of a lagoon in the South Pacific island of Tongareva, which a museum expedition visited aboard the yacht of Templeton

Crocker, San Francisco explorer. To assure accuracy, members of the party descended repeatedly in diving helmets, finding the water so transparent that they could see 150 feet at four fathoms' depth. Pearl divers used no more elaborate equipment than goggles. Ten tons of coral were required to reproduce the submarine scenery.

*Photos by Charles Coles,  
American Museum of Natural History*



This figure represents a native of the South Sea island of Tongareva, gathering pearl shells . . . .



. . . while a grisly octopus glides toward him from a near-by cavern. The setting copies an actual scene



# 4,200,000 meals a day

— — Is an Easy Order for the  
Army's Cooks and Bakers

By ARTHUR GRAHAME

**K**EEPING 1,400,000 always-ready-to-eat American soldiers healthy, happy, and rarin' to go with 4,200,000 scientifically balanced and appetizing meals a day is quite a job. Yet the Quartermaster Corps is handling it so successfully that replacement-center officers complain that after a month or so trainees strain the seams of uniforms that were too large for them when they were inducted.

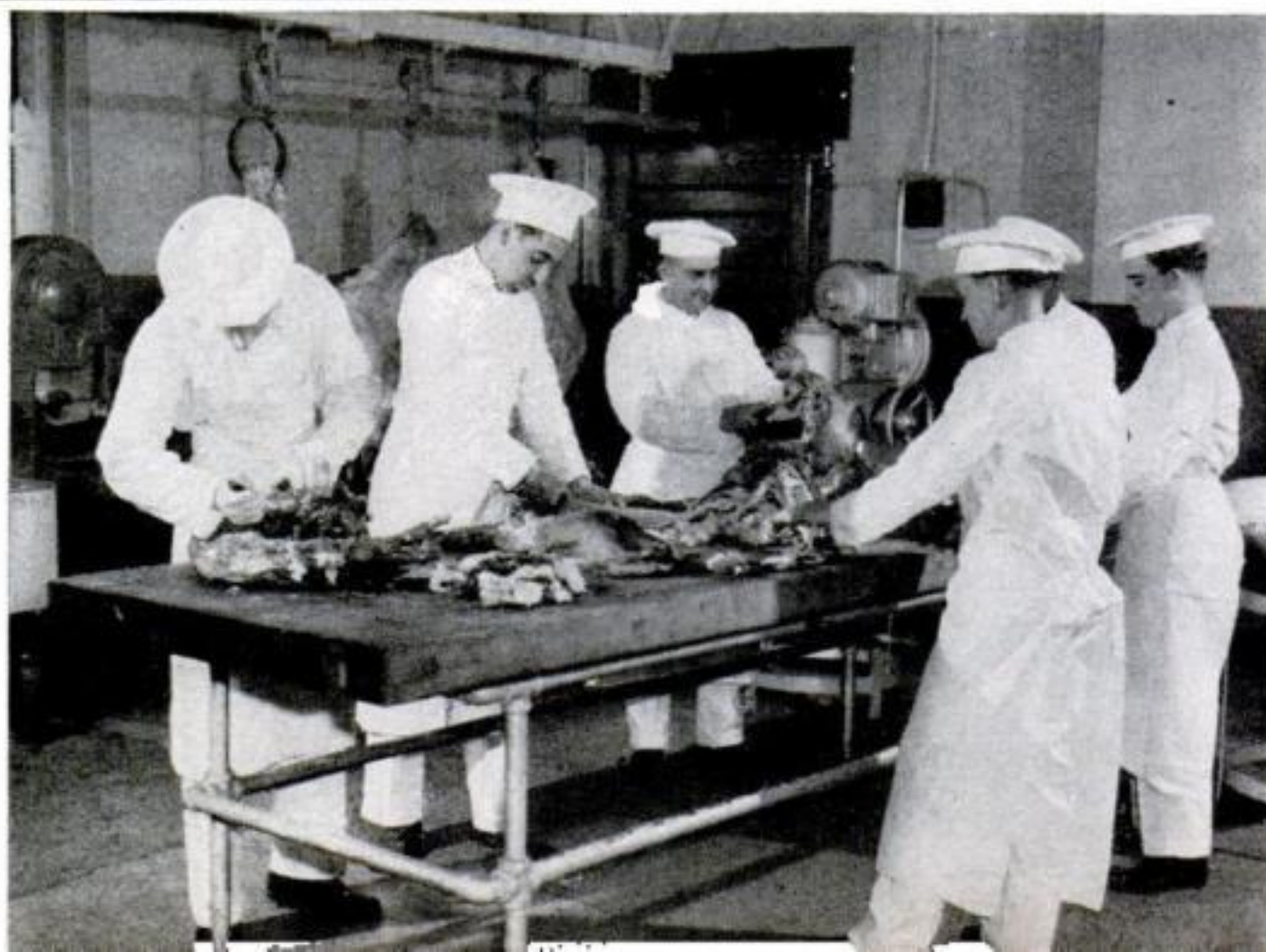
The American soldier is the best-fed trooper in the world. He gets more food, better food, and better-balanced food than does the soldier of any other country. The chances are three to two that he eats better than he did at home—nutritionists say that the Army is being fed better than is 60 percent of our civil population. Expert dieticians see to it that he averages 5,000 calories a day, although from 4,500 to 4,800 suffice for laborers doing the hardest kinds of work. Every bit as important, the food is cooked and served in a way that makes eating it a pleasure.

The fellow who wants his roast beef



The Army eats better than 60 percent of the civil population, the nutritionists agree. Each man gets 5,000 calories a day, though 4,800 are enough for laborers doing the hardest kind of work

The cooks are trained to get the most out of cuts of meat, in looks as well as value. This is an important item as the Quartermaster Corps buys a million pounds of meat a day





almost raw is out of luck—most people like it medium well done, so that's the way the Army cooks it. A Bostonian wrote home for a pan of baked beans—nowadays that stand-by of 1918 shows up only Saturday noon, and that wasn't beans enough for him. Then there are old soldiers who kick about the food on principle. But I've asked a lot of the men—Regulars, Guardsmen, and trainees—what they think of Army food, and nearly every one of them said: "Swell!"

Back in the days when the Army numbered 150,000 men, each corps area bought its own staples and each post its own fresh meat, milk, vegetables, and other perish-

ables. Today the New York office buys all the Army's sugar, coffee, baking powder; Chicago, all its canned meats and vegetables, cereals, flour, and evaporated milk; San Francisco, canned fish and canned and dried fruit. Thirty regional centers buy the perishables.

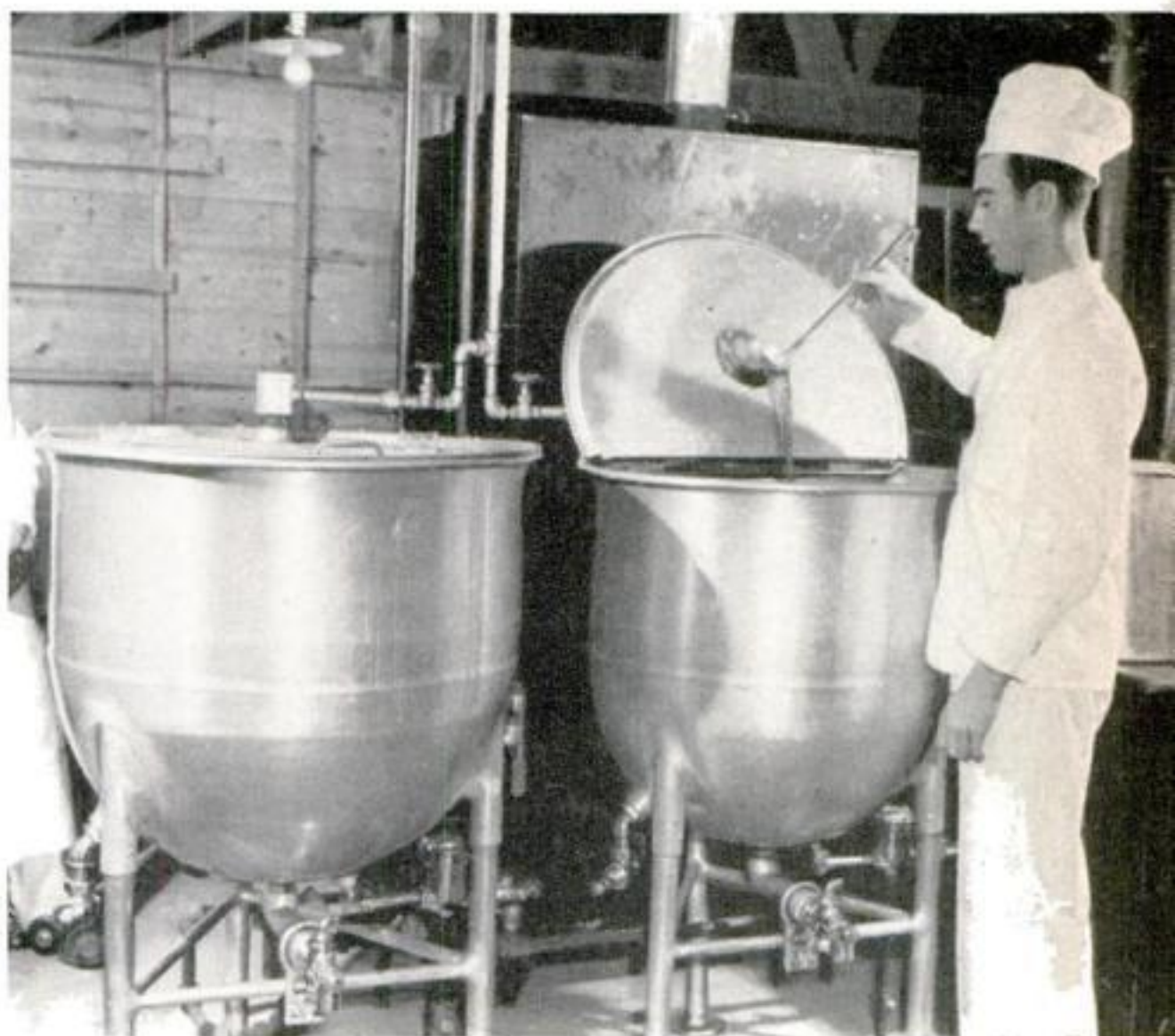
In this way the Army spends well over \$600,000 a day for more than 6,500,000 pounds of food—a million pounds of meat, two million pounds of bread, 600,000 pounds of potatoes, 500,000 pounds of fresh fruit and vegetables, 700,000 quarts of fresh milk. It is buying a twentieth of this year's pack of canned fruit and nearly a tenth of the

### BARLEY SOUP

7 gallons beef stock  
3 pounds barley, pearled  
2 pounds onions, chopped  
Salt and pepper to taste

Thoroughly mix all ingredients and boil for 1 hour. Ten minutes before serving add enough beef stock to make 10 gallons of soup. Season to taste.

It takes big pots to cook ten gallons of soup at a time, and the ingredients must be thoroughly mixed if "season to taste" is to mean anything. And breaking 150 eggs for a 100-man omelette is a chore that can't be done while the coffee is perking. It's a problem even to keep count of that many, much less to whip them up fluffily with eight quarts or so of milk



PLAIN OMELETTE  
150 eggs  
8 cans milk, evaporated, condensed with 8 pints water  
or 8 quarts fresh milk  
2 pounds drippings or fat  
Salt and pepper to taste  
Mix the eggs and milk, season, and whip well. Put drippings or other fat into the bake pan, and when the fat begins to smoke pour in the mixture, not more than 3 inches deep. Bake in a medium oven.



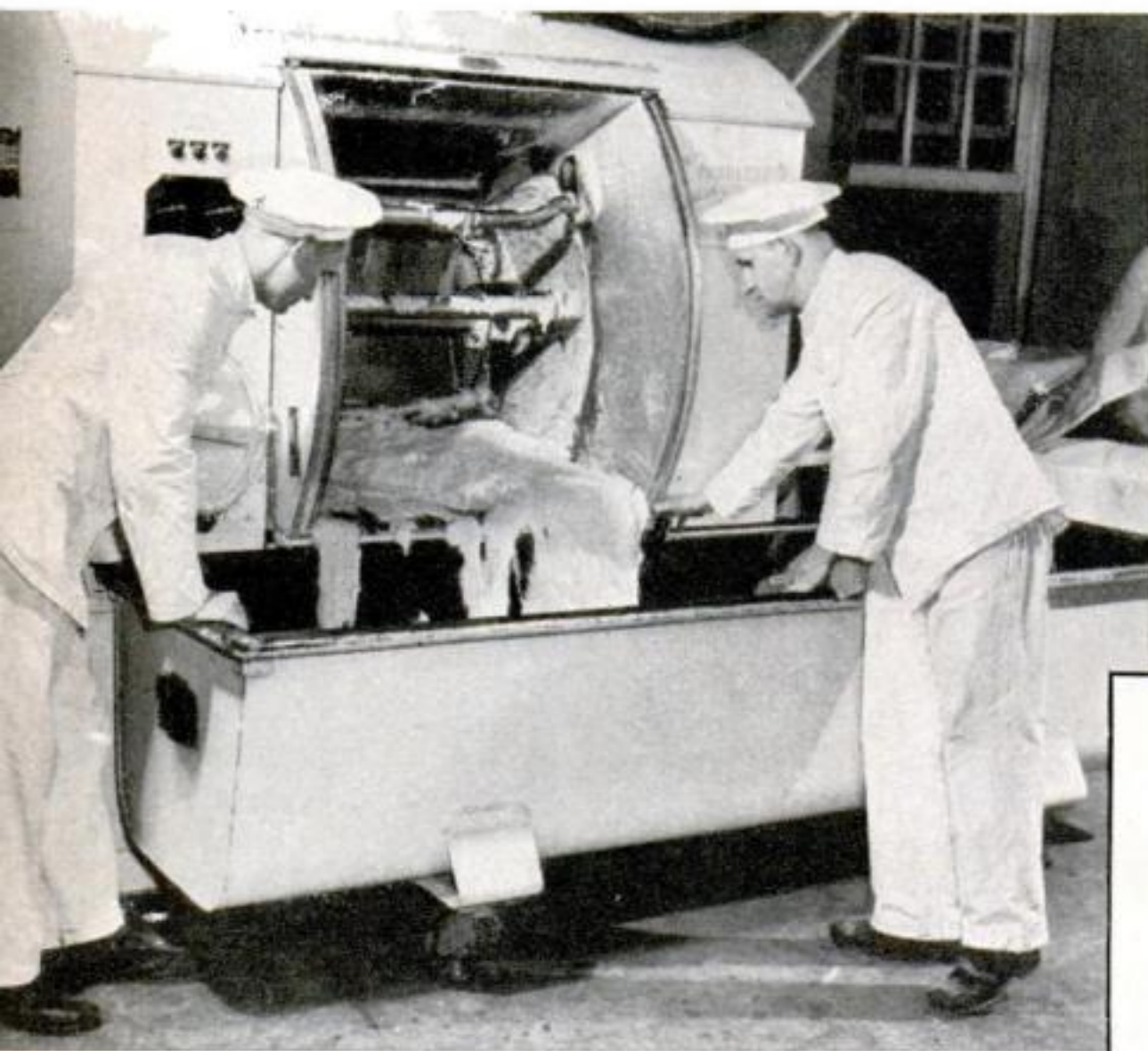
pack of canned vegetables. Its purchases of meat for canning are so heavy they are monopolizing all our meat-canning facilities.

The Army's food-buyer-in-chief is Lieut. Col. Paul P. Logan. A veteran of 1918, he has been student and instructor at both the Quartermaster Corps Subsistence School in Chicago and the Army Industrial College in Washington, and is rated a top-ranking food expert. He and a few others worked out the plan for feeding a big-time Army back in the pre-Munich days.

Assisting him are several dollar-a-year men and ten representatives of the food industry. Buying on the advice of business

men who know all the angles of the food trade has saved taxpayers several million dollars and promises to save more. Most food men have coöperated, but in some cases prices have "step-laddered"—the highest prices which receive contracts on one invitation to bid become the lowest bids next time. When this happens the Quartermaster Corps rejects all the bids and negotiates contracts.

In camp, the men are served Field Ration A—fruit every day; half a pint of milk and an egg a day for each man, with condensed milk for cooking; plenty of vegetables, fresh in season and canned; cereals, meat, and cheese. In practice, troops on maneuvers get about the same. Quartermaster depots are established at rail or truck heads, and refrigerator cars substitute for cold-storage plants. Division headquarters order what they need each day, and the division's own trucks—usually from 12 to 15—pick up its supplies. In case the refrigerator cars are left behind, however, there is a Field Ration B, made up of canned meats, dehydrated



#### BREAD

100 pounds of flour  
65 pounds of water  
2½ pounds of yeast  
2½ pounds of salt  
4 pounds of sugar  
1 pound of malt (optional)  
5 pounds of shortening  
4½ pounds of milk, dry skim,  
powdered  
¼ pound mineral yeast food  
(optional)

NOTE.—Water absorption may vary. Use the necessary quantity more or less than 65 pounds to get desired dough consistency.

Army bakers mix their dough in machines that look like concrete mixers. They must allow for the friction of the machine in tempering the water, but that's less trouble than taking a big spoon to 100 pounds of flour and other ingredients in proportion. The dough drops into long fermenting troughs. The recipe will make 89 of the Army's 18-ounce loaves



and canned vegetables and fruits, with plenty of tomatoes and concentrated lemon juice to make sure there is enough Vitamin C.

Field rations C and D are for men to carry where field kitchens cannot follow. C comprises three hearty meals packed in six small cans weighing around five pounds. D is a chocolate bar, combined with oat flour, so it won't melt—or tempt the men to eat it before it is needed. Each bar, which is reinforced with vitamins, yields 600 calories, and a man can carry several into battle. Both were developed at the Subsistence Laboratory, in Chicago.

The psychological aspects of eating receive attention, as well as vitamins and calories. Colorful desserts enliven the mess tables and the cooks are careful not to serve spinach and string beans on the same plate because the combination looks too green. Here is a typical menu:

Breakfast: Figs, shredded wheat with fresh milk, fried eggs, toast, and coffee.

Dinner: Barley soup with croutons, roast lamb, potatoes, Bavarian cabbage, tomato salad, tapioca pudding, and coffee.

Supper: Chop suey, boiled rice, spinach and shredded eggs, pickled beets, cinnamon rolls, apple sauce, and coffee.

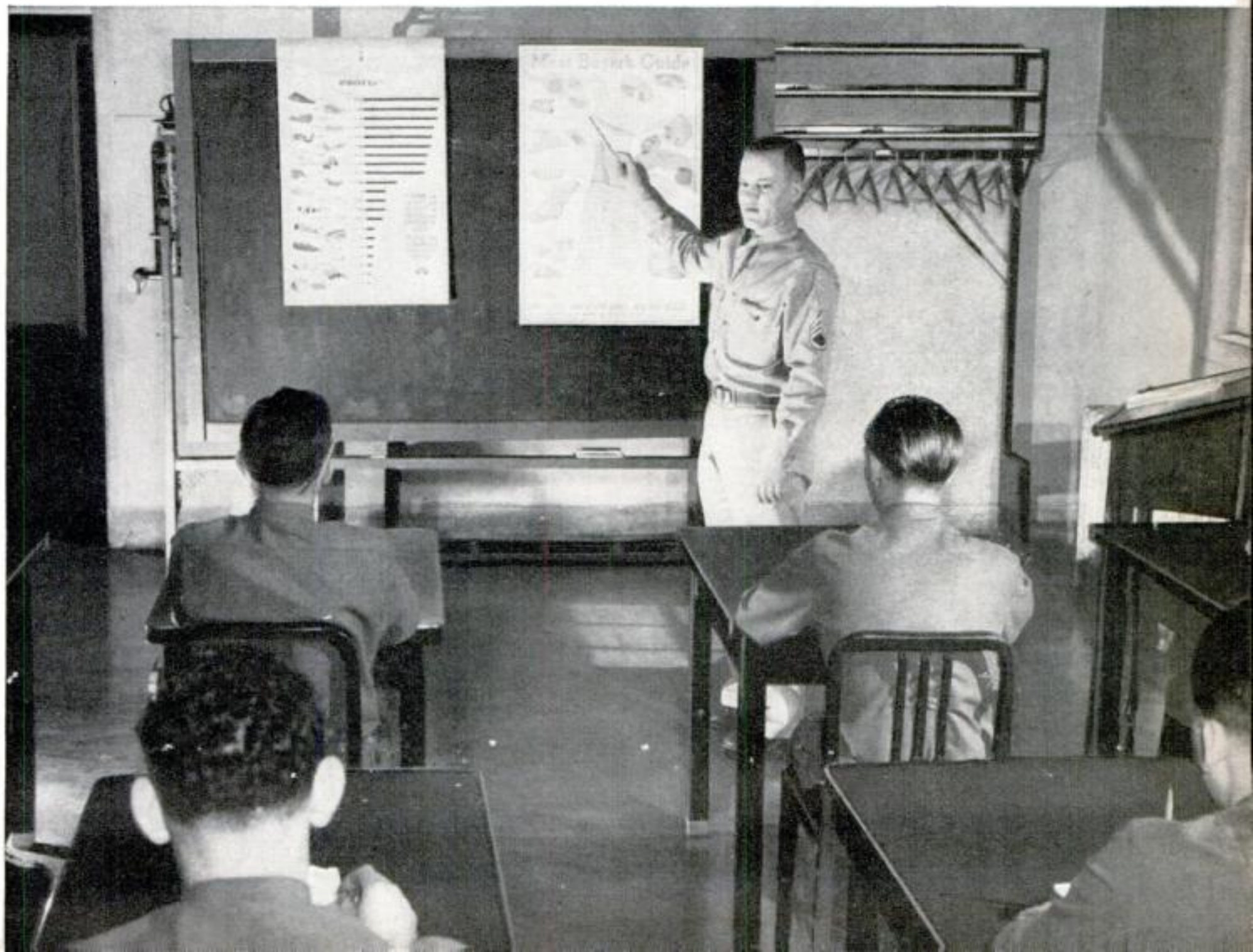
Much credit for the Army's more appetizing meals belongs to a brisk little woman named Mary I. Barber, who says she became a dietician because of the fondness for good eating she inherited from her Pennsylvania Dutch ancestors. Lent by the Kellogg Company, she is the Army's only dollar-a-

year woman. She has the "last say" on what the soldiers eat. A quartermaster officer in each corps area prepares menus for all the troops in his area, and sends them to Miss Barber in Washington. She makes any changes she thinks desirable and returns them. Copies then go to the officer in charge of the commissary at each post, in time for him to order from the three chief buying offices and his regional market center well ahead of the date



All foods are tested, for the Army eats only the best

Both cooks and bakers are put through a 13-week course of training, and mess sergeants an additional six-week course. Here, at one of the schools, of which there are several in each corps area, the instructor explains the various cuts of meats, and how to get the most out of a side of beef or a hog





he will want the food.

Cooks and bakers attend a 13-week course, and cooks selected to become mess sergeants an additional six-week course. They also learn to fight, for nowadays, when the rear has a way of becoming the front, everyone in the Army has to know how.

Soldiers still have to do kitchen-police duty, but in the larger cantonments veterans rub their eyes when they see clean white spuds pop out of an electric potato peeler, with which two men in a couple of hours can do a job which used to keep a dozen cussing all afternoon. There also are electric dough mixers, meat choppers and slicers, toasters and dishwashers, steam kettles and deep-fat fryers. This makes food handling more sanitary, and also keeps the men from losing much time from training. Most camps have their own bakeries, and many their own refrigeration plants, run by quartermaster companies especially trained for that work.

Adoption of the gas-line range has improved the preparation of food in the field. It provides a better fire than the old wood-burners, is smokeless, and doesn't get so hot it can't be moved in a hurry—important in present-day warfare. One cook working three of these ranges in a moving truck can prepare a hot meal for 300 men on the march.

A century or so ago one N. Bonaparte, who knew his warfare, remarked that armies move on their stomachs. The Quartermaster Corps is determined that the American Army will move on a full one.



## FIELD KITCHEN 1917

An ash pit had to be dug for the wood-burning field stove used during the first World War, so it couldn't be used on the march. It couldn't be moved quickly, and it smoked, which was a dead giveaway to the enemy. All this did not matter much in trench warfare, but motorized troops who had to depend on such stoves would eat cold food most of the time

## EMERGENCY RATIONS

WHEN the troops go where field kitchens cannot follow them they carry six small cans for each day's ration. Three of them contain six crackers each, soluble coffee, lumps of sugar, and a chocolate bar, and three contain a meat and vegetable combination, such as beef stew, pork and beans, or hash. All the food is pre-cooked, but it tastes better if it is warmed. Each of the cans weighs 12 ounces and carries its own opener.

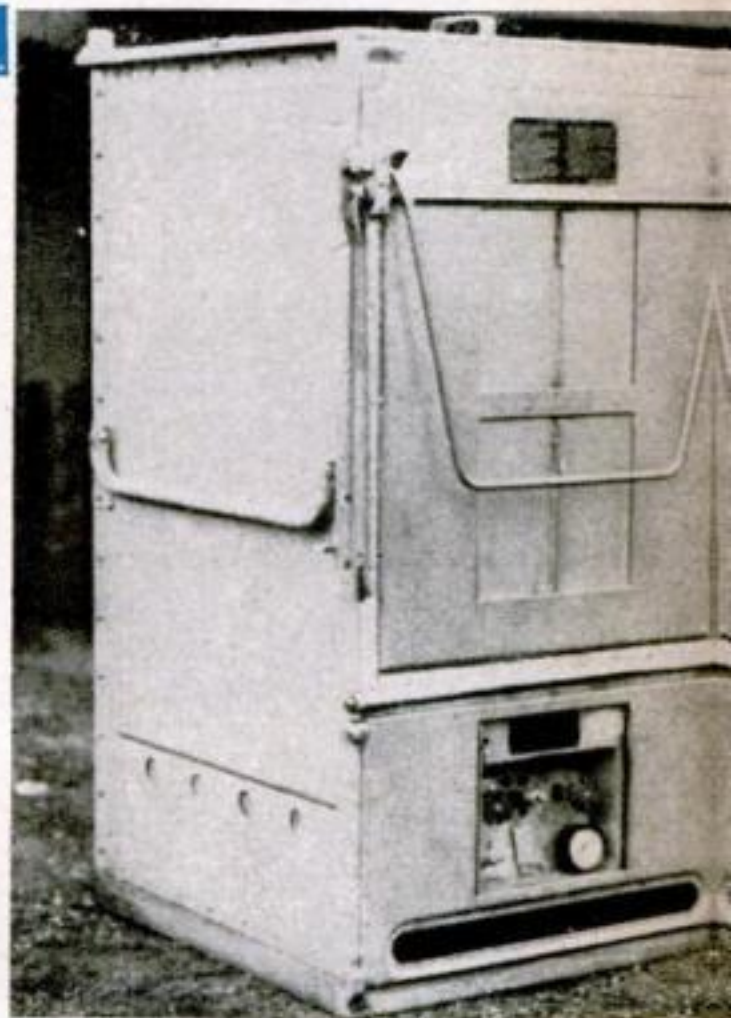






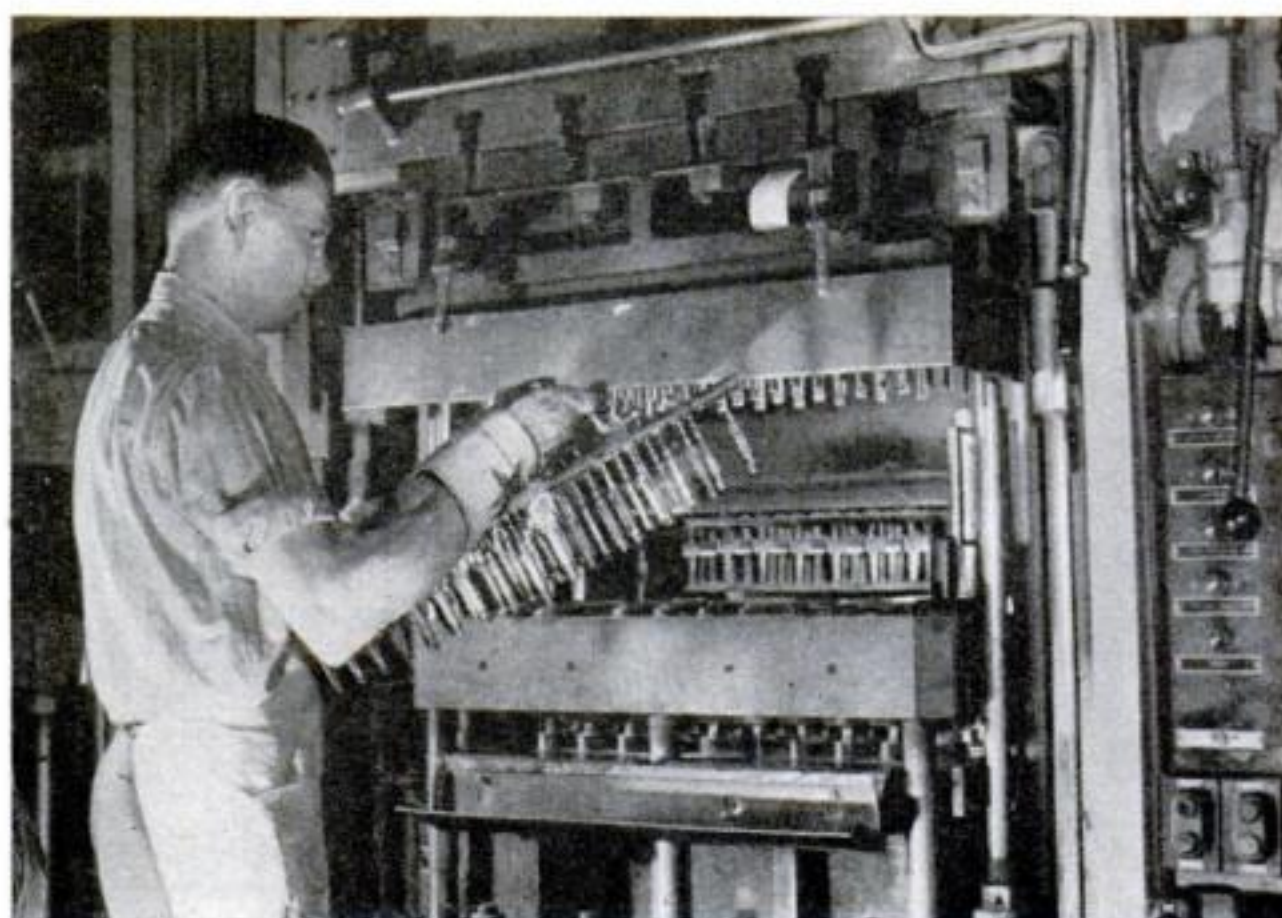
## FIELD KITCHEN 1941

Today's smokeless gasoline range not only can be moved quickly, but one cook, working three of them, can fix a hot meal for 300 men while traveling 40 miles an hour. Its two cooking compartments, as shown below, are adapted to varied uses. At right, ready to travel. Below, pumping air to provide a hotter flame





# HEATPROOF SPARK PLUG BOOSTS WARPLANE EFFICIENCY



Batteries of these automatic molding machines press insulator material to the desired shape. It then passes through the world's hottest commercial kilns. Left, one of the new aviation spark plugs



Because the insulators, second in hardness only to the diamond, have slightly rough surfaces, workers like the one shown inspecting them must wear rubber finger-tip covers to prevent wearing their skin raw

**A**N ARTIFICIALLY made semiprecious stone—second in hardness only to the diamond—forms the insulator of an aviation spark plug now being mass-produced for Uncle Sam's air forces. Chief features of the new insulator are its resistance to destruction by the lead in aviation gasoline, and its ability to withstand punishing heat without cracking or becoming leaky. Tests conducted prior to the absorption of the entire output of the manufacturer by the Government are said to have shown that the insulators last longer than conventional spark plugs, thereby reducing the cost of maintenance and replacement and increasing the time that the planes are available for use.

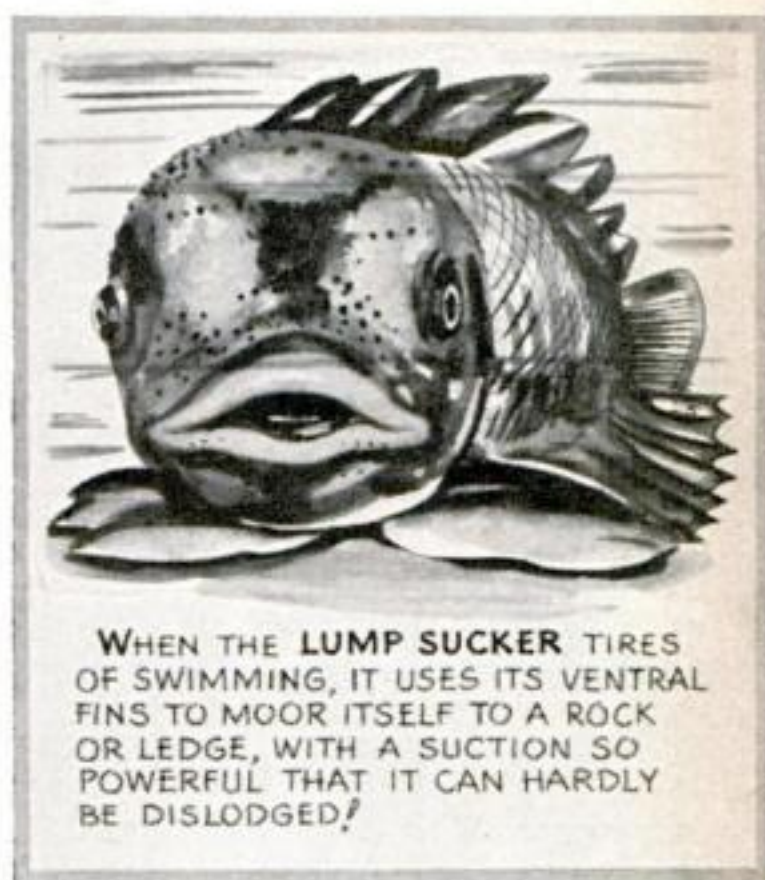
The plug is a development of the A C Spark Plug Division of General Motors, Flint, Mich., whose research engineers spent ten years perfecting the machinery and

technique for its manufacture. While many of the details are secret, it is known that the basic material for the insulator is aluminum oxide. It is mixed with a binder and molded to shape under pressure and heat. Then, for a period of hours, it passes through a butane-gas-fired kiln hotter than any commercial kiln ever used before. When it emerges with the binder and impurities burned away, it is the stuff of sapphires, rubies, and Oriental amethysts, and will scratch any substance but the diamond.



# Un-Natural History

BY  
*Gus Mager*





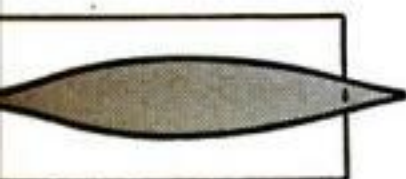


Another underwater fighter for our two-ocean Navy. Subs are being built even at Great Lakes shipyards

## Subs Spawned in Fresh Water Make a Strange Trip to Sea

WITH coastal yards jammed to capacity, Uncle Sam is having ten of his newest submarines built at Manitowoc, Wis. When they are completed, he will find himself almost in the position of the man who built a boat in his cellar and couldn't get it out. The 310-foot craft will have to be transported down the Mississippi to the Gulf as illustrated at the right. Even with part of the superstructure removed, a submarine will need to be half submerged—its "light" draft of 12 feet increased to a "deep" draft of 21 feet—to be towed under low bridges of the Chicago Canal, the tightest squeeze of the route. From New Orleans it will proceed under its own power to New London, Conn.

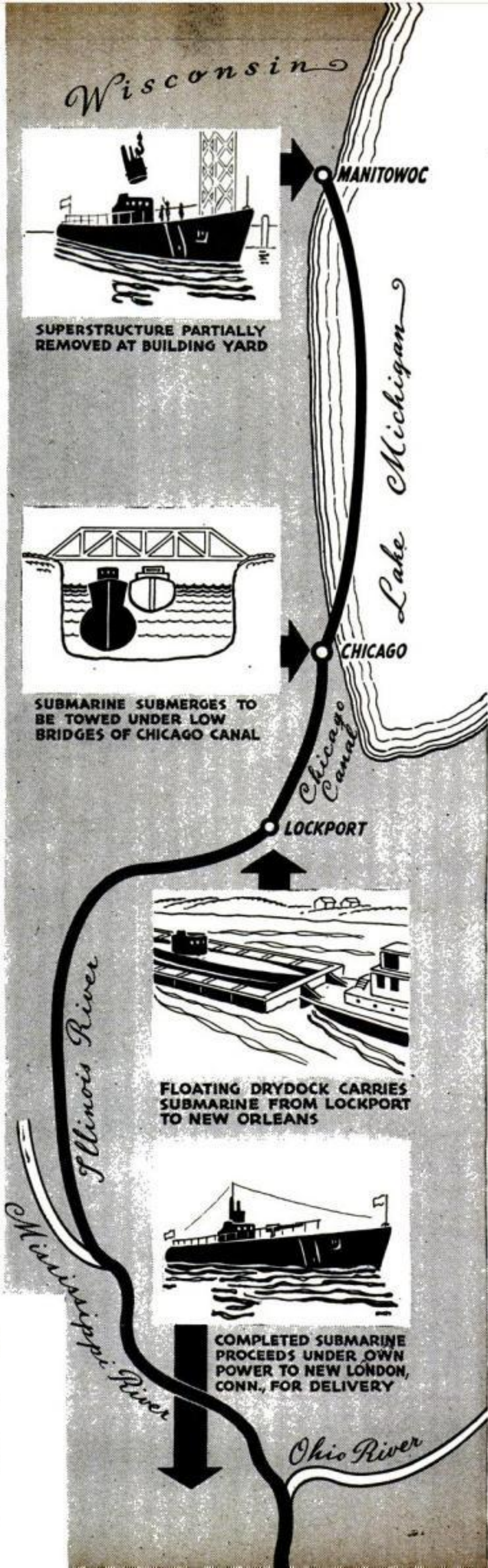
WHY DOWN THE MISSISSIPPI? The size of the submarines makes it impossible for them to use customary routes to the sea



310-FT. SUBMARINE IS TOO LONG FOR LOCKS OF WELLAND CANAL AND ST. LAWRENCE ROUTE TO SEA



NEW YORK STATE BARGE CANAL IS TOO SHALLOW TO FLOAT SUBMARINE





## Parking Truck for Trailers Takes Them Going or Coming

NO MATTER which way he's going, the driver of the novel parking truck shown below always has a clear view ahead. When he wants to travel in the opposite direction, he simply climbs over into the seat facing

him, and operates a duplicate set of controls. His single steering wheel works from either position. You see him stowing away a truck trailer at the Keeshin Terminal, huge motor freight depot in Chicago.



"Switching" trailers in a truck-freight yard. When he wants to go the other way, the driver changes seats

## Dashboard Signal Lights Tell When Tire Pressure Gets Low

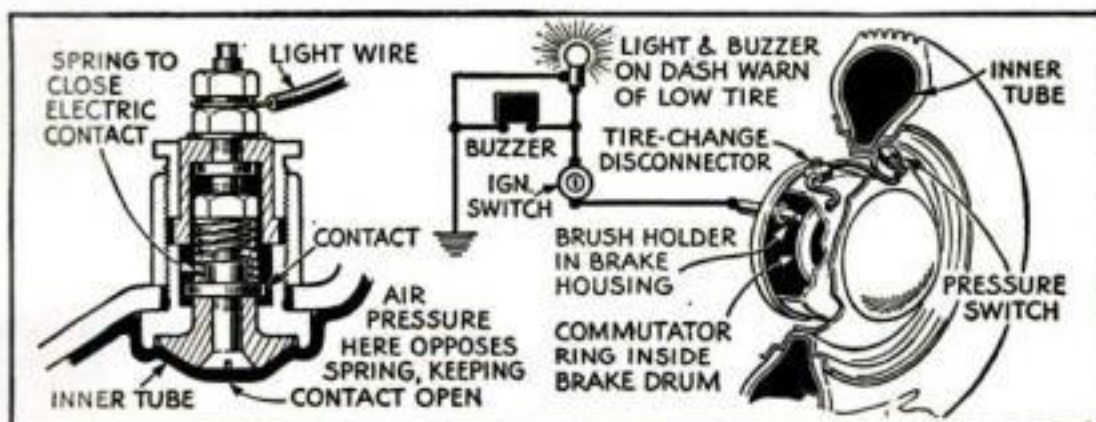
WARNING a driver by means of a buzzer and dashboard lights when tire pressure falls below any desired minimum, a signal system for trucks and cars is being marketed as a safety and economy device. A pressure-operated switch in contact with

the tube in each tire operates its own light, indicating the tire in need of attention. An insulated commutator in the brake drum and a fixed brush on the brake housing connect the unit to the ignition switch, which also turns the system on or off.



Each "jewel" light on dashboard (left) is connected with a tire. When it lights that tire needs air

All you see on the wheel is the pressure switch (right). The diagram shows a hook-up permitting any number of wheels and spares





## Paratroopers Travel Light —More 'Chutes Bring Gear

**D**RESSED in foliage-green coveralls and wearing plastic helmets which look like a football player's, the Army's parachute troops go over the side armed only with pistols and hand grenades. Dropped by parachute at the same time are heavily padded, 200-pound roll packs, containing their rifles,

submachine guns, ammunition, and even their regular infantry packs of blanket roll, half a pup tent, toilet articles, change of underwear and shirt, emergency rations, mess kit, and trench tool. A parachute trooper must roll when landing if he is to avoid injuries, and it is almost impossible to do this carrying a heavy pack, much less a rifle. The helmets are crash affairs, covering the ears, forehead, and back of the neck, and attached to them are straps leading to a heavy pad that passes over the chin.



Parachute troopers, landing armed only with hand grenades and pistols, hurry over to padded rolls dropped from planes.



Each roll contains submachine guns or rifles, plus rations and other equipment too bulky for carrying in the descent.

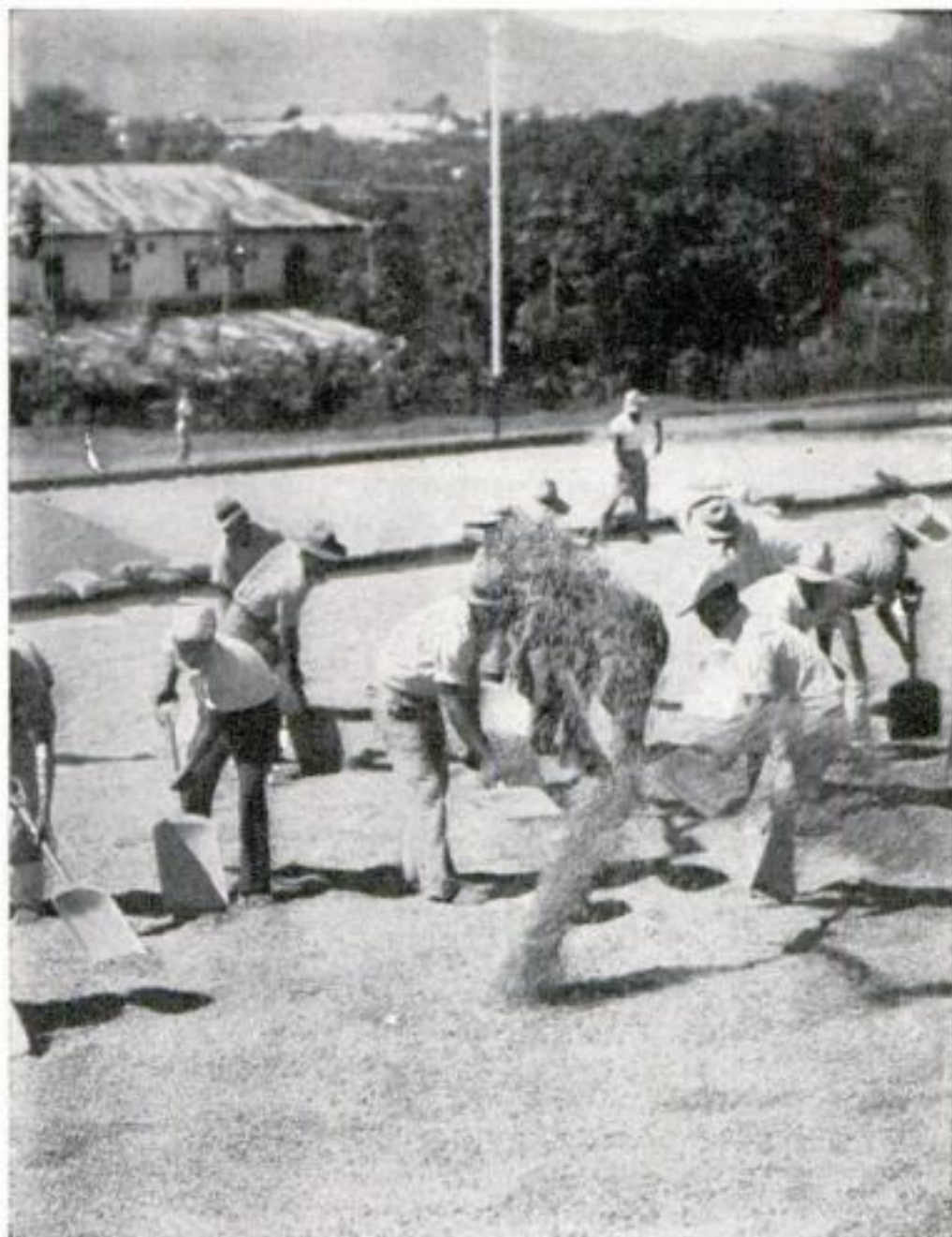


Once he has picked up his rifle the parachutist fights like any other infantryman. Notice the plastic helmet.



# Plastics from Coffee to Use Brazil's Surplus Crops

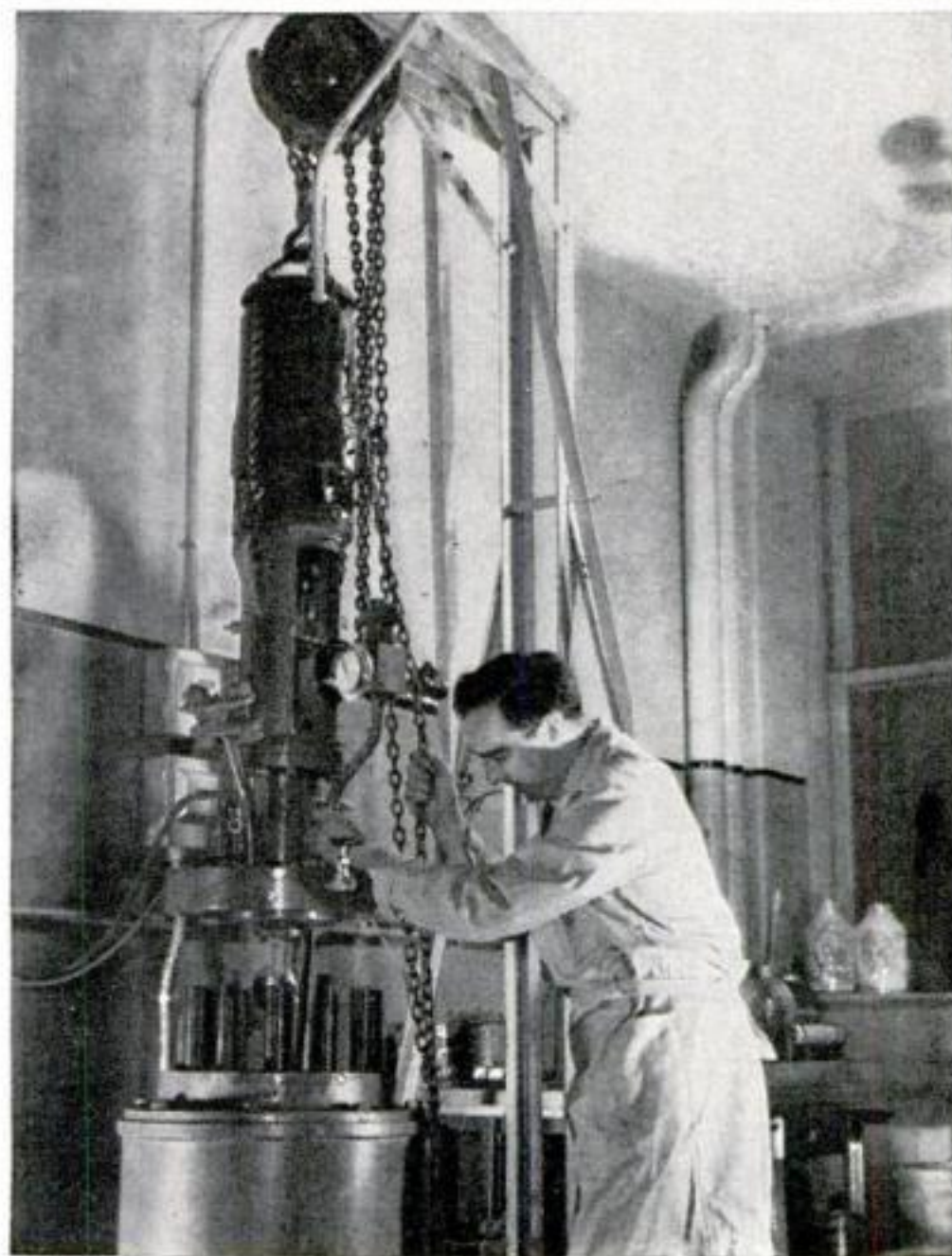
By BARRETT MCGURN



IN THE LAST ten years, to keep the price up, Brazil has dumped into the sea or burned enough coffee to give every man, woman, and child in the United States three cups a day for two and a half years. This month the Brazilian Government will begin turning a part of this surplus into a plastic. It expects to sell the product in this country at from seven to ten cents a pound, or from a half to two-thirds the price of the cheapest plastic now on the market. The five-story factory going into production at São Paulo will make only 4,250,000 pounds of the powder a year, but Brazil thinks so much of the process it has already awarded tentative contracts to the Blaw-Knox Company, of Blawnox, Pa., for the machinery of a second plant to turn out 100 times that much.

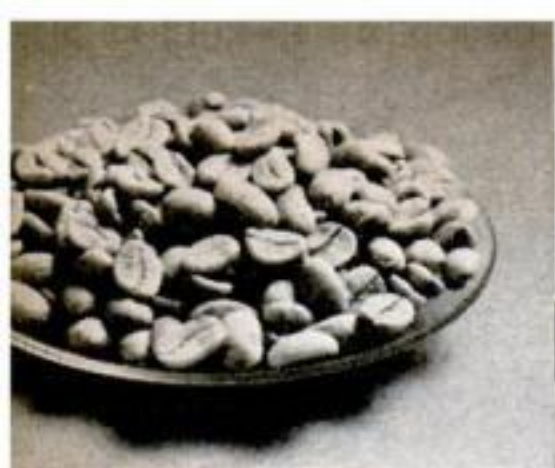
That will be more than half the present world consumption of plastics, but Brazil is not worried. Until recently the industry was growing at the rate of 30 percent a year, and there is a world shortage just now, because of the call for plastics to replace aluminum and other metals reserved for defense use. Besides, the price of Caffelite, as the stuff is called, makes it possible for it to compete with lumber and plywood for flooring, wall boards, and roofing, particularly in prefabricated houses.

The burning and dumping led directly to the discovery of the new use for the bean. The waste preyed on the mind of a California chemist named H. S. Polin, now 33 years old, and three years ago he began studying coffee to find out whether it was not good for something besides drinking. His findings were spectacular, and in November, 1939, Brazil dispatched a scientific mission to the United States, headed by Dr. Paulo Carneiro, head of the Technological Institute



At the top, green coffee beans being spread out to dry. Steel drums wrapped in steam jackets, similar to the laboratory autoclave at the left, will heat under pressure the ground-up beans, to which water and a catalyst are added, to make plastic powder





The green coffee beans . . .



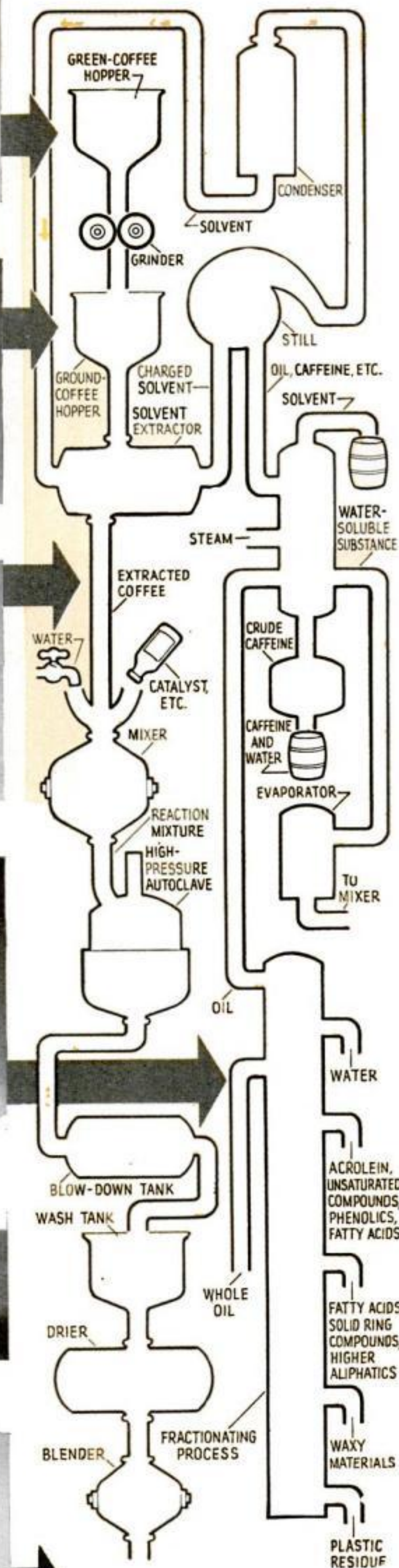
. . . and husks are ground



After the oil is taken out



The oil has its uses, too  
The plastic, ready to mold



## The Bean Yields Every Ingredient Needed in Plastics

Green coffee berries are fed into a large hopper. They do not have to be shelled, so husks and all are ground up fine, much as the roasted beans are at the grocer's to make your morning cup. Solvents take out the caffeine and oil. Distilling the oil provides fractions which are poured back along with water and a catalyst. The mixture is heated under heavy pressure in an autoclave. Washing removes the catalyst and other soluble material, leaving the plastic powder, ready to be dyed and molded.



of Brazil, to investigate Polin's remarkable claims.

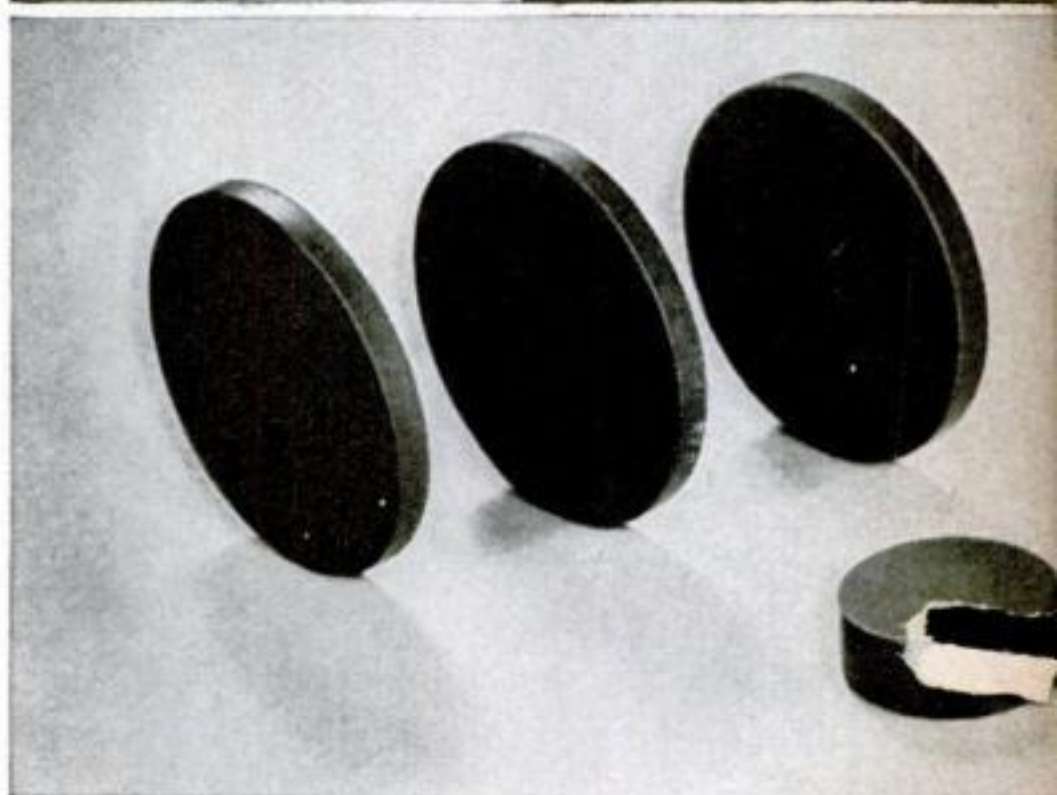
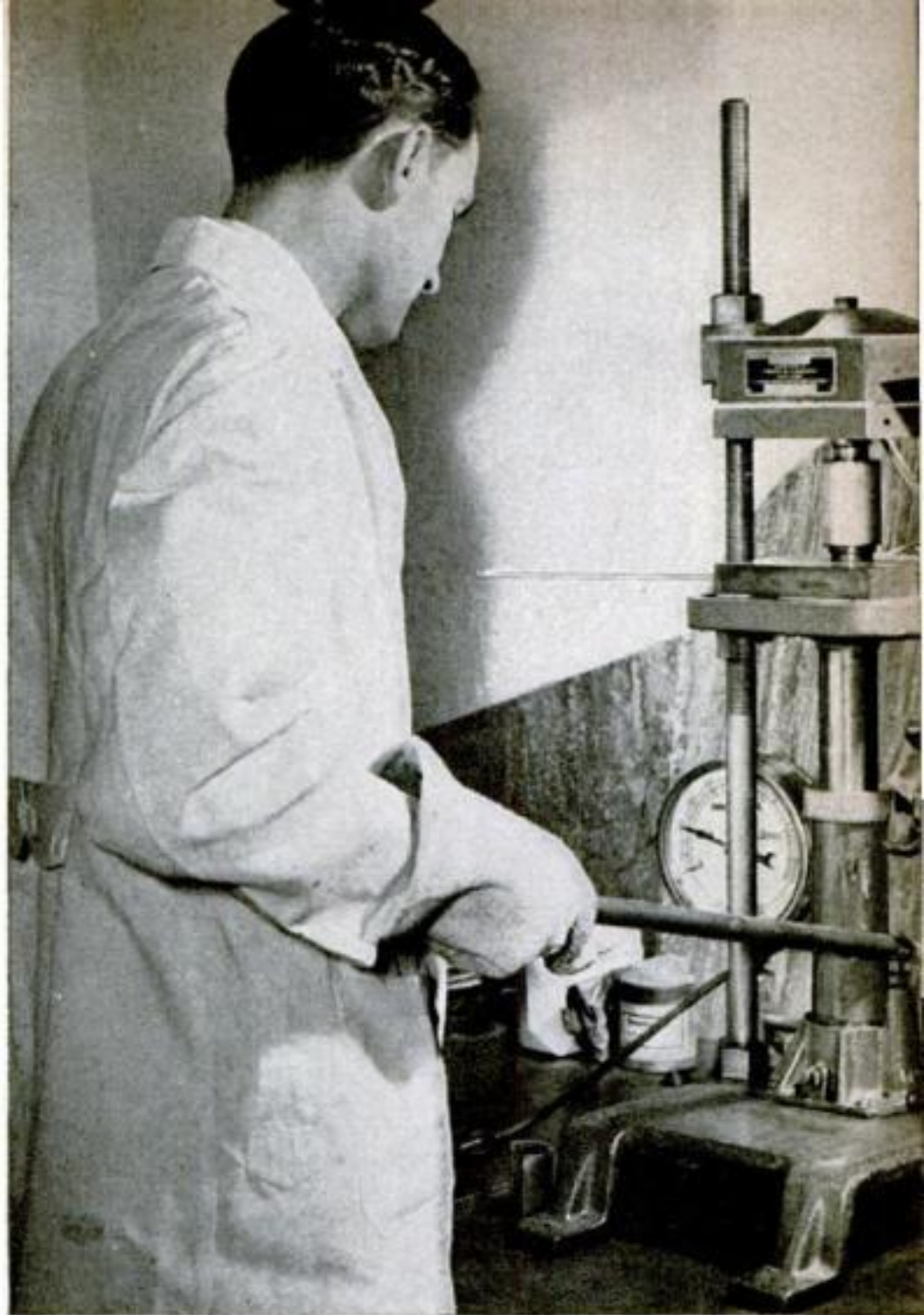
Polin showed them how he extracted a powder from the bean, and molded that powder under pressures of from 2,000 to 5,000 pounds to the square inch into permanently hard objects highly resistant to water, heat, alkalis, and weak acids. He pointed out that it is a good insulating substance, and finally that in its manufacture there are many useful by-products that will justify production alone if the market for plastics ever is saturated!

The Brazilian scientists were impressed, and Brazil determined to make Caffelite as a government enterprise. Polin turned over his patent rights, and will receive royalties for 15 years in exchange.

Each 132-pound bag of coffee will yield a pound of caffeine and two gallons of coffee oil, plus more than 100 pounds of plastic. The small plant now starting will have a capacity of 50,000 bags a year, while the big plant will have a capacity of 5,000,000 bags a year, which means it can produce, as a sideline, twice the world's present consumption of caffeine. However, there is a shortage of caffeine at present, owing to the war, and a larger future market is promised by recent discoveries of new uses for it. Coffee oil may be used in soaps, lacquers, paints, shoe polish, food products, medicines, insecticides, and as a source of Vitamin D. Brazil also has an eye on the tin-plate industry, in which coffee oil can be used as a substitute for palm oil. Other by-products are cellulose and furfural.

But it is the new plastic that arouses the greatest enthusiasm. The bean includes not only all the plasticizers and bulk materials needed, but even the dyes to color the finished article! Green, tan, dark brown, and black are on hand in ample quantities. Other colors are there, too, but extracting them would draw on chemicals needed for other qualities in the Caffelite, so dyes will be added when they are desired. Finished objects can be any color but not dead white. Coffee is too dark to take so light a shade as that. Mottled as well as solid colors will be possible.

Both types of plastic, the thermoplastic and thermosetting, can be made from the bean. The thermoplastic type can be melted and remolded as often as desired. The thermosetting type, by far the more common, remains permanently hard. Caffelite can be made either opaque or translucent,



A Carver laboratory press makes test cakes of Caffelite under pressures of 2,500 to 5,000 pounds to the square inch, at temperatures of 325 to 375 degrees Fahrenheit

though never glass-clear, and either hard or rubbery.

Polin is conducting further experiments with the bean in his laboratories 71 stories above New York City's 42nd Street, in the Chrysler Tower. The possibility of whole houses being built of Caffelite is in his mind and those of his assistants, but Brazil is pretty well satisfied with what he has already done to convert an annual loss of \$50,000,000 into an asset.



Self-sealing bulletproof tires for Army vehicles are among the new defense contributions of rubber. Here a rifleman is taking a shot at one mounted on a test carriage that reproduces load and traction conditions of real service



# *Defense brings a* **NEW AGE OF RUBBER**

By CHARLES MORROW WILSON

**R**UBBER news is stretching around the world. Current progress in rubber manufacture is probably the most rapid and varied ever attained by an American industry.

Headline rubber news is defense news. Of the 34,000 rubber-built articles now under patent or pending patent, nearly 25,000 are helping build our new Army, Navy, and Air Corps. Our present defense effort is the biggest developer of rubber since 1839, when a Philadelphia hardware merchant named

Charles Goodyear accidentally spilled a mixture of crude rubber and sulphur upon a hot stove and thereby "invented" vulcanizing.

Rubber can do much toward deciding the outcome of this war. With steel and petroleum, rubber is now the greatest military material. Field guns, tanks, armored cars, and transports; planes, field kitchens, hospitals, horses, and mobile plane-repair shops are rolling to war on rubber tires or tracks. Our Army marches on rubber heels, and a big part of it on rubber-composition soles as well. Each one of our military vehicles re-



quires an average of 300 rubber parts or fixtures. A new bomber uses 400, and our new 35,000-ton battleships more than 20,000.

Last winter we were able to fly bombers and pursuit planes to England because of rubber de-icers on their wings. Planes are also equipped with "self-sealing," bullet-resistant fuel tanks lined with rubber.

Already, defense uses have hoisted our rubber consumption to an all-time high of 67,000 tons per month—as compared with Germany's estimated consumption of 100,000 tons per year. The giant Nazi military machine is still predicated upon steel and other metals. We are learning that for many uses rubber lasts longer, moves faster, is more resistant to high speed, intense heat, and other battle conditions than is steel. For the past four years 90 percent of all

tractors in manufacture have rolled on rubber tires for an average saving of one third of fuel and maintenance cost and a 25-percent increase in working speed.

Our new Army profits accordingly. Our tanks and planes are taking to rubber. For example, our standard 28-ton light tank, the M-3, now uses more than 1,600 pounds of rubber. Like all new-style tanks it rolls on rubber tracks—lugs of hard rubber vulcanized upon steel cores which turn on bogie wheels or rollers, also made of solid rubber vulcanized upon steel rims.

Thus rubber works against rubber, instead of steel against steel, to increase speed; to reduce strain, vibration, and dead weight; and to muffle noise to a point where our new tanks can receive orders by radio in the thick of battle.

Another remarkable attainment is the all-rubber mount for antiaircraft guns, particularly the 40-mm. Swedish Bofors now the standard defense of England. Each mount has about 1,500 parts. Mechanical earth drills now used by our Army (they can dig a 20-inch hole six feet deep in three minutes) also travel on rubber tires. Porous rubber cushions and mattresses are standard aids to the performance of "bunk fatigue." Sponge rubber pro-

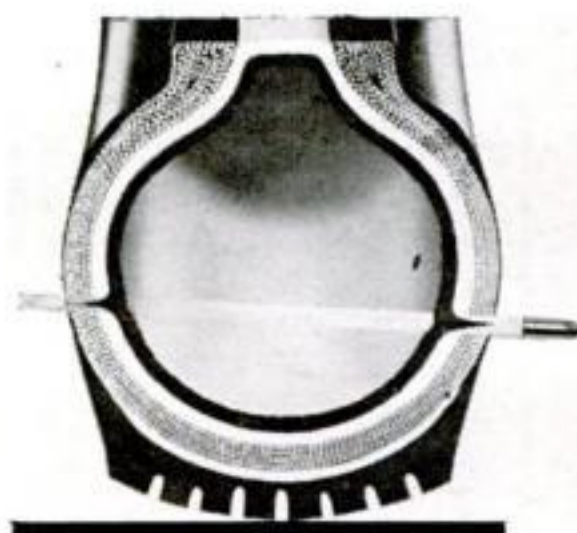
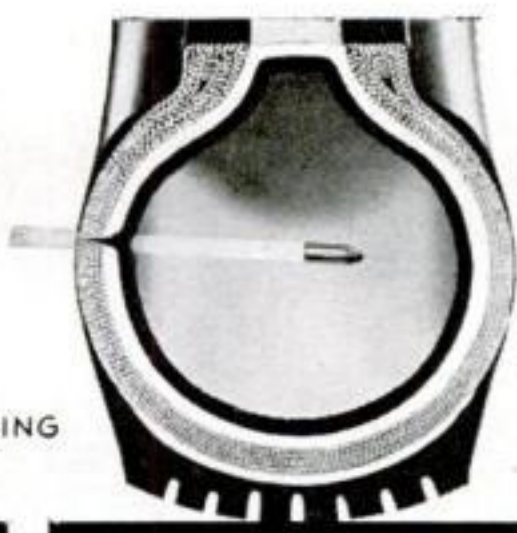
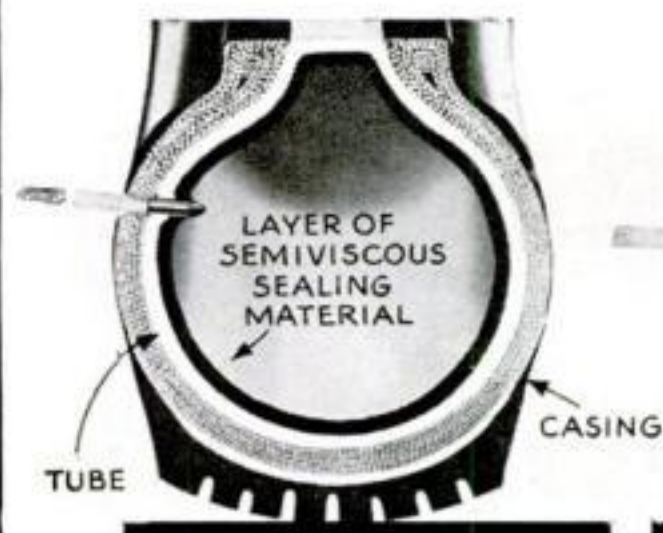
With several bullet holes in it, the tire can keep running under load without losing more than a few pounds of its air pressure



BULLET ENTERS  
SIDE OF CASING  
AND PIERCES  
INNER TUBE

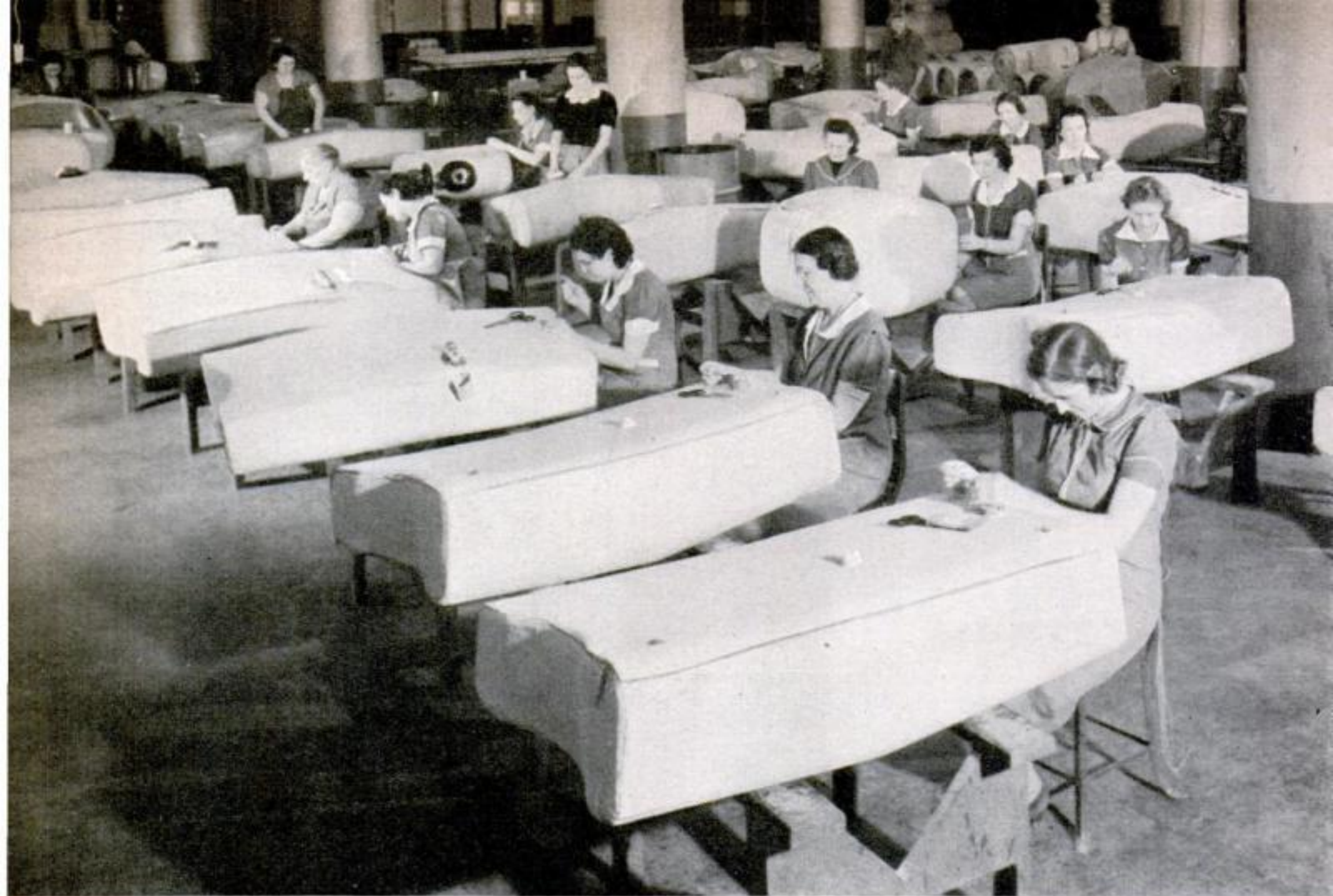
AIR PRESSURE  
IN TUBE FORCES  
SEALING MATERIAL  
INTO BULLET HOLE

FIRST HOLE IS SEALED,  
SEALING MATERIAL  
IS FORCED INTO  
SECOND HOLE



Here's how the bulletproof tire works. In passing through the tire, the projectile punctures an inner layer of a jellylike rubber compound which is forced into the hole in the casing, sealing the leak at once





Similar in principle to the bulletproof tire is the self-sealing fuel tank for combat planes, shown here in course of manufacture at one of the plants of the B. F. Goodrich Co., Akron, Ohio. With tanks like these, a warplane need not crack up or catch fire because of an unlucky hit by an enemy machine gun

protects our soldiers who serve inside the tanks. Sponge-rubber pads guard the feet, legs, and arms of our parachute troops.

Since our Army began to move on rubber, enormous progress is being made in improving tires. Most spectacular is the development of the self-sealing bulletproof tire, equipped with gum-type elastomers which close bullet or shell punctures. In tests, clip after clip of high-powered .50 caliber bullets are fired at close range into a self-sealing tire. Then the tire is transferred to a military vehicle and run for an hour or more with pressure losses no greater than ten pounds. The self-sealing fuel tank, now standard in our fighting aircraft, is an application of the same principle.

Substitution of rayon for cotton threading for military tires is also adding enormously to the life and heat-resistance of the casings and tubes. Our progress in construction of airplane tires and tire brakes is even more spectacular.

Military craft must be prepared to make rough, fast landings, and the resulting grind upon tires, particularly with bombers, is great. Today the world's biggest airplane tires are being manufactured by Firestone for the new Douglas B-19 bomber. This is a 36.00-40 casing. Though adapted to the

standard tricycle landing gear, the tire is built to carry half of the bomber's total weight of 82 tons. Standing eight feet high, this tire weighs 961 pounds and has a tread which carries five inches of rubber. To build one such tire requires 600 pounds of crude rubber, 148 miles of cotton cord, three miles of steel piano wire for beading, and 300 pounds of compounds.

A new Firestone heater unit designed to "cure" or vulcanize tires from eight to ten feet in diameter weighs 300,000 pounds and stands 2½ stories high when the lid is opened.

New rubber-base face-molded gas masks are among the most important of all defense equipment. Our rubber factories are now manufacturing at least 7,000,000 of them. The mask is entirely seamless except for one small seam beneath the chin, which is sealed with rubber. Before delivery the entire mask, hose included, is tested under tremendous pressure to insure against leaks.

Aviation uses of rubber are increasing almost as rapidly as our output of bombers. One is the recent development of tires which conduct static electricity into the ground and thus eliminate a serious fire hazard. Our rubber industry has taken over production of barrage balloons, one tested form



of protection against aerial bombardment. This construction is extremely complicated since it involves perfecting and rigid inspection of suitable rubberized fabrics, inflation equipment, stabilizers, and seam-taping with specially developed rubber adhesives. Control or "weather-surfacing" wings of military craft is another important new job in rubber. So is insulation of delicate aviation instruments.

Collapsible rubber boats or "life rafts" for all military aircraft which fly above water are an outstanding development in rubber use. Rubber acid tanks, bomb jackets, and gas-line guards are other important items. Rapid development of rubberized or rubber-derived tenting materials points to a time when air bases, like circuses, can be "pitched" overnight. These weatherproofed tents and shelters are already enormously important to our land forces. The rubber-built oxygen mask for high-altitude flying, heat-retaining rubber boots and zipper suits for military flyers, and flame, gas, and grease-resistant coverings both for men and vital engine parts prove rubber's place in air supremacy.

Today's race for world leadership becomes more and more literally a race for rubber. To date we are far ahead. Despite their publicized facilities for making synthetic rubbers, the Axis Powers seem most anxious to get natural rubber. The Italian Government is striving unsuccessfully to adapt guayule or bush rubber to dry-land Africa. Germany is reputedly attempting to smuggle out South American tree rubber by means of planes and "runner" ships. According to rubber authorities, Germany consumed about 100,000 tons of rubber during 1940—about one seventh of our present consumption. Most of it was synthetic and the rest was salvage from numerous con-



**MAKING SYNTHETIC RUBBER** is demonstrated in a simple experiment by A. R. Bowlzer of the Goodrich company. Synthetic latex made from petroleum or farm waste is poured in a beaker

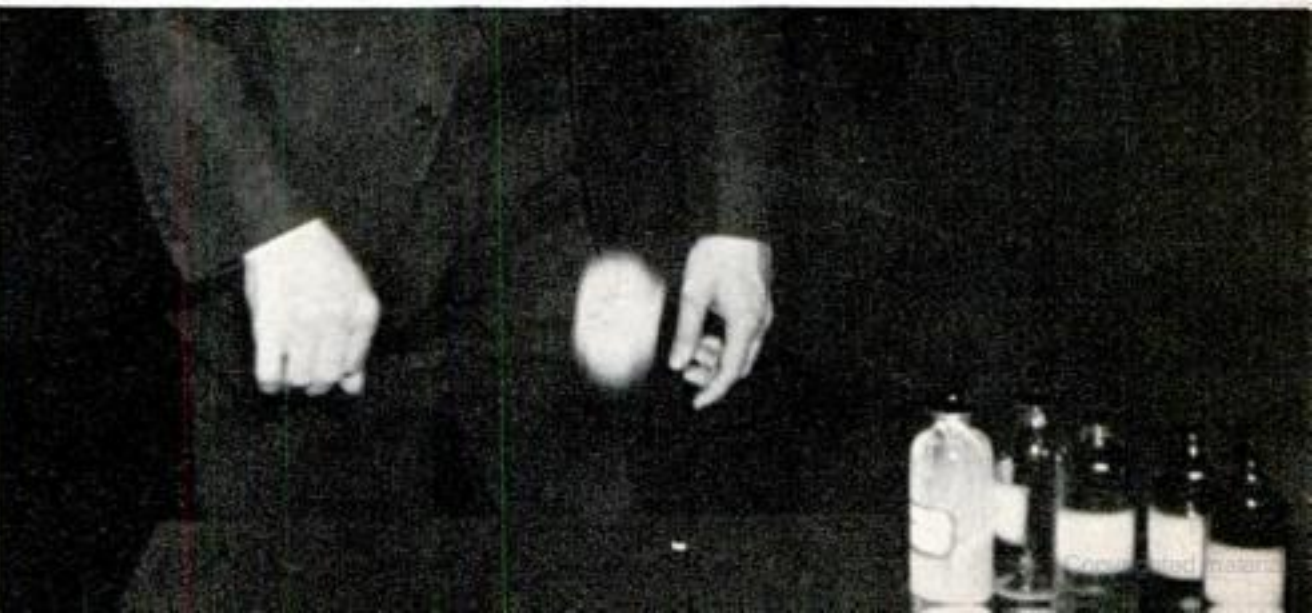


**LIKE NATURAL LATEX**, the artificial material is coagulated by the addition of dilute acid. When stirred, the solution begins to curdle almost at once, the rubber in it forming a spongy mass



**MAN-MADE RUBBER** resembles the natural product so closely that only an experienced technician can tell them apart. Goodrich is now turning out six tons of this material a day at a new plant

**IT BOUNCES!** Synthetic-rubber plants in the United States now have a capacity of 18,000 tons a year, will soon make it 40,000





quests. Our rubber authorities believe Hitler's rubber-salvage schemes, though efficient, will be hard to keep up. For it is usually necessary to use at least two pounds of fresh rubber with every pound of salvaged. In any case, Germany's 1941 consumption of rubber is thought to be no more than two pounds per capita, while ours may reach 15 pounds.

That is why rubber is a source of income for about 15,000,000 American families, and why our rubber industries are paying an overall average wage of more than a dollar per hour. It is why our rubber industries can afford to employ thousands of research workers, whose efforts are opening thousands of new domestic uses.

Among the army of new household uses for rubber is Pliofilm, a transparent, odorless, tasteless, and moisture-proof sheeting now being manufactured at the rate of

about 25,000,000 yards per year. There are two types of this material; the plasticized (for hard wear) and the regular, which is primarily a wrapper material, impervious to water, air, grease, mold oil, alkali, or heat; printable and sealable either by sewing or by heat adhesion. Use of rubber-film packing will help prevent possible shortages of alloys and metals used in manufacture of "tin" cans and metal containers. Baker's yeast, buttermilk, molasses, malt, and malted milk are on the new list of foods being packaged in rubber-made containers.

Products both of natural and synthetic rubbers are making headlines in the clothing field. For example, the U. S. Rubber Company announces a new type of "hole-proof" rubberized hosiery, which according to laboratory tests wear 100 days, 15 hours per day, without developing a break. The same fabric processing can create rubber-



**1** Hevea rubber trees, prime source of natural latex, are improved by budding grafts from carefully crossbred "mother trees" to rootstocks



**2** In harvesting, white latex flows out of the inner bark of the tree through a spiraled "wound" into an aluminum cup. Two trees must be tapped for a year to get the rubber for one tire

**3** Every morning, a tapper visits each tree. He scrapes off the congealed rubber into a scrap pan, cuts a new slit in the bark, and attaches the cup. A man can gather 100 pounds of latex in a day



ized undergarments and work clothes which promise to set all-time records in durability.

Sheer rubber raincoats, in varied and attractive colors and capable of being carried in pint cartons or oversize wallets are common merchandise. So are rubber bathing suits which stretch three diameters and return to their natural size and shape. Other rubberwear includes light transparent "heat retainers" for the feet, which can be placed inside one's shoes for skiing, hunting, trout fishing, or ice-skating.

These products are also made of rubber hydrochlorides. So are the transparent "glamor gloves" which women now wear for home and office work. The list of rain garments is expanding to include complete rain suits and hoods which fold into a five by eight-inch package weighing only half a pound and easy to fit into a golf bag, tackle box, or glove compartment. The rubber-treated rayon does not shrink, scratch, or stretch.

Rubberizing of common papers is made possible by Pliolite, a vaporproof rubber derivative which is also being used as an invisible furniture protector. Another substitute rubber called Koroseal is developed and manufactured by the B. F. Goodrich Company from limestone, coke, and salt. This material is essentially a coating surface and is particularly important in construction and insulation of modern battleships and fighting craft. To date the new sea fortress *North Carolina* is its biggest customer. The product is resistant to flame, mustard gas, oil, water, and acids.

United States capacity for producing synthetic rubber is now about 18,000 tons per year. When new plants are completed, or within two years, capacity will probably be between 36,000 and 40,000 tons or five percent of total rubber needs. Goodrich is com-

pleting its third synthetic-rubber plant within 18 months. Firestone is completing a new "substitute" factory, as is Goodyear. Du Pont, Dow Chemical, and Standard of New Jersey are among prominent non-rubber concerns now active in developing and producing rubber substitutes.

At present, most of our synthetic rubbers are by-products of petroleum. About 80 percent of all the butadiene now used is a product of the petroleum-cracking processes recently developed to improve aviation gasolines. Though normally a gas, this source is handled under pressure to keep it a clear, watery liquid. For making "Buna S" or synthetic rubber for auto tires, coal-tar derivatives such as styrene are added. To make "Buna N," or "perbuna" for manufacture of various mechanical goods, acrylonitrile, another coal-tar derivative is added.

Buna has unusual resistance to abrasion, which accounts for its use on printing-press rolls and blankets, and its resistance to heat, swelling, and aging makes it a superior insulation. Buna-type rubber can be made from a great many sources other than petroleum. The product was first developed with crude cane syrup of the type commonly used for industrial alcohol, and it can also be taken from cornstalks, straw, grain hulls, sawdust, scrap wood, and many other cellulose materials. Dr. Waldo Semon of Goodrich, one of our most renowned developers of synthetic rubbers, tells me that when bigger producing units and larger capital investments are directed toward Bunas, it is probable that large quantities of field and crop wastes could be made to provide cheaper synthetic rubber than petroleum offers.

But at present more than 90 percent of all our rubber comes from the latex of the tropical Hevea tree, a stately, shiny-leaved

4

Poured in open pans, the latex is covered with diluted acid as in the experiment on page 99. This coagulates it into spongy white pads which are run through wringers and smoked or dried as small sheets seen in the photo at left, and baled for export



tree native to the Amazon Basin of South America. Two Hevea trees must be tapped for an entire year to yield enough rubber to make one six-ply tire for a cheap auto. Thus our auto tires alone consume the harvests of about 6,000,000 Hevea trees along with those of a half million acres of high-yield cotton and about \$70,000,000 a year worth of other products such as zinc oxide, copper, sulphur, pine tar, clay, mica, and rosins.

UNTIL 1900 the world's supply of Hevea rubber came from the wilds of South America where it was collected by native tappers or "seringueros" and bought by free-lance jobbers and speculators. Under those conditions the highest South American production was 89,000 tons in 1910. That wasn't enough to meet demands of the fast-growing auto industry, which continues to consume about three fourths of all rubber used. Rubber booms resulted and prices of crude rubber soared to \$3 per pound.

Meanwhile, after long experimentation the British and Dutch governments succeeded in adapting the South American tree to British Malaya, the Netherland Indies, and other eastern tropics as a plantation crop. Today British Malaya, a small archipelago no bigger than New York State grows about 44 percent of the world's rubber supply; the Dutch colonies of Java and Sumatra grow about 40 percent, while Indo-China, Liberia, and the Philippines grow most of the rest. South American recovery of wild rubber is only about one percent of our present imports.

Today most of our rubber supply must travel 12,000 miles or more over shipping lanes threatened by Axis raiders, and beyond defense by any navy. Shipping time is from eight to twelve weeks and Dutch and British merchant ships which carry most of the traffic are being continually sent to the bottom.

Except for Hevea the only currently practical source of natural rubber is the guayule shrub, a stubby, grayish-green bush which is native to the dry Central Plateau of Mexico. Recently this plant has been introduced to farms in Arizona, New Mexico, and California. At Salinas, Calif., the Intercontinental Rubber Company, leading promoter of guayule, has built a mill with a five-ton daily capacity; has planted about 8,000 acres of the homely bush, and with the assistance of the U. S. Army and Department of Agriculture is developing a supply of seed for use in emergency.

Since guayule thrives upon land too dry for most commercial crops and is a legume or nitrogen-restoring plant, a bill is being introduced in Congress to subsidize guayule planting throughout our dry Southwest. It

is a less profitable crop than Hevea, since the entire plant, including roots, must be dug and put through mechanical shredders to make possible recovery of the latex which is in the wood. The best yield on record is about 350 pounds of crude rubber per acre, but depending on variety rubber yields range from one to 20 percent of the plant's weight. In the wild, four or five years are required for the plant to come to bearing.

Hevea trees bear for 25 years or longer with yields ranging from 400 pounds per cultivated acre for unimproved stock to maximum yield of 1,900 pounds and averages of 1,200 pounds yearly for highly improved varieties. Therefore our rubber men and the Government are seeking to return Hevea to plantations of Central and South America within safe distance or protected sea lanes. It cannot be raised in the United States.

Henry Ford has pioneered this effort by developing two modern Hevea plantations at Belterra and Fordlandia, along the Tapajos River of Brazil, the "botanical cradle" of the tree. Ford plantings now include about 15,000 acres with 3,000,000 trees, which are expected to yield about 12,000,000 pounds per year of crude rubber within another five years. In 1935-36 Goodyear established two Hevea plantations in Central America; one near Gatun, Panama, the other at Cairo, Costa Rica. The latter property is now in commercial harvest and during March, 1941, the Ford Motor Company began manufacture of tires made from Hevea harvested at Fordlandia, Brazil.

GOODYEAR also owns and operates about 60,000 acres of high-yielding Hevea plantation in Sumatra. The U. S. Rubber Company operates its own plantations in Java and Malaya. The Intercontinental Company continues to harvest and refine guayule rubber in Mexico and California. In Liberia, West Africa, Firestone has Hevea plantations totalling 72,000 acres or about 9,000,000 trees. This development was begun in 1926 and the properties now yield about 1,100 pounds of rubber per acre, or about 10 percent of Firestone's needs. Most of the harvest is brought to the United States as liquid latex.

The U. S. Department of Agriculture is establishing ten Hevea experiment stations throughout Central America with headquarters at Turrialba, Costa Rica. Department surveys indicate that 15 Latin American countries, from Mexico through Bolivia have extensive lands capable of producing Hevea commercially. The Department is trying to interest native farmers in the crop.

Hevea agriculture is reasonably simple. The tree comes to bearing within seven or



eight years and yields from seven to 13 pounds of sheet rubber per year. Bud-grafting and selective breeding are the progress factors in growing the crop. Healthiest and highest-yielding trees are selected, and by means of cross-pollination seedlings can be developed with the best qualities of both parent trees. Thus the improved family is established as "mother trees." Buds from these trees are grafted to hardy seedling rootstocks. Since the tree breeds true to type and without throwbacks, one mother tree can provide buds for several hundred acres of high-yield plantation.

It is a perpetual harvest. Each morning the tappers, equipped with sharp knives, buckets, and a refuse pan, visit the trees, slitting thin spiraled "wounds" in the trunk bark of each tree. The tapper scrapes the congealed rubber into his scrap pan and clamps an aluminum cup immediately below the newest wound. The white latex flows out of the cambium layer of the inner bark. The worker carries both the fresh sap and the scrap rubber back to the curing shed, or pours the sap into orchard pipe lines. Sap

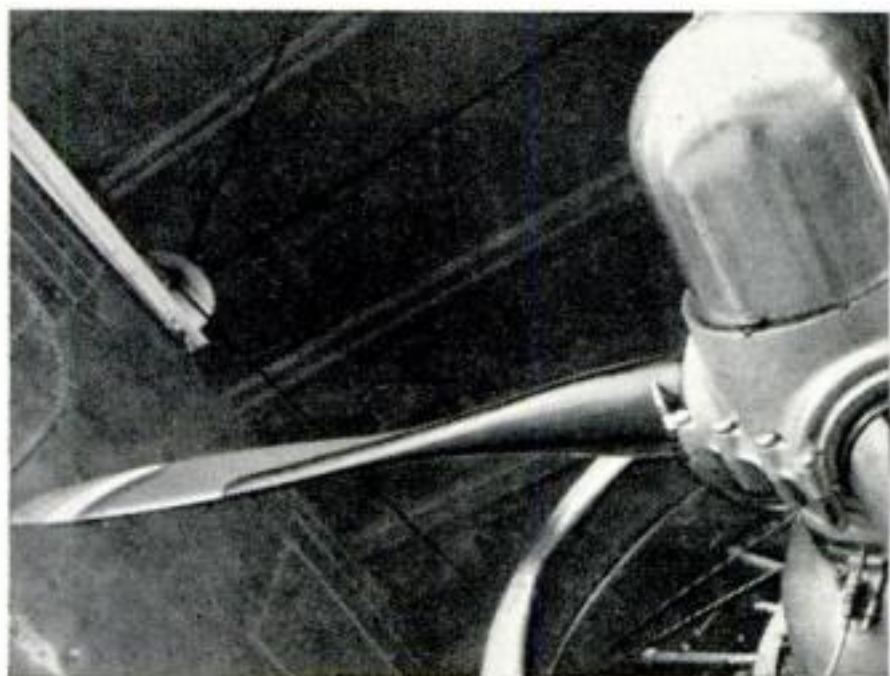
flows best in the morning. Between dawn and noon a good worker can collect 100 pounds of latex which makes about 35 pounds of sheet rubber.

The next step is to pour the latex into open pans and cover it with a layer of dilute formic acid. The latex coagulates into a spongy white pad which is put through wringers, then smoked or dried with hot air into small sheets which are packed into 200-pound bales for export.

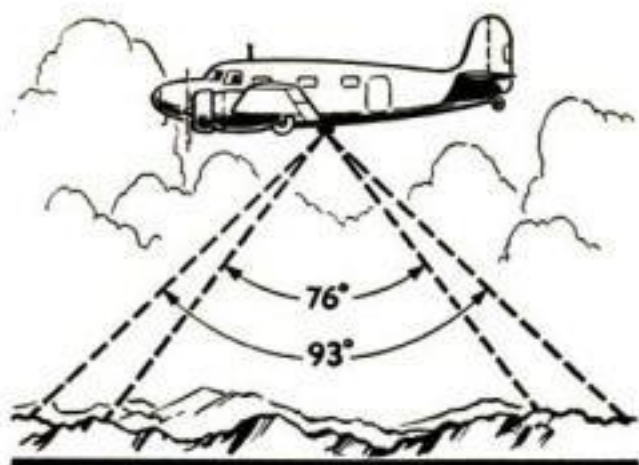
At the factory entrance a hydraulic plunger forces these bales into a "pie-cutter," a set of revolving knives. Chunks of rubber travel on conveyors to the mixing mill, which merges the rubber with one or more of about 9,000 chemicals or compounds, some of which have the longest names ever spoken by man—such as mercaptobenzo-thiazole. The factory chemist writes the "prescription" and the compounder, one of the highest paid of rubber workers, weighs out the ingredients.

That gives rubber chemist, engineers and technicians more time for imagining and making a new world of rubber.

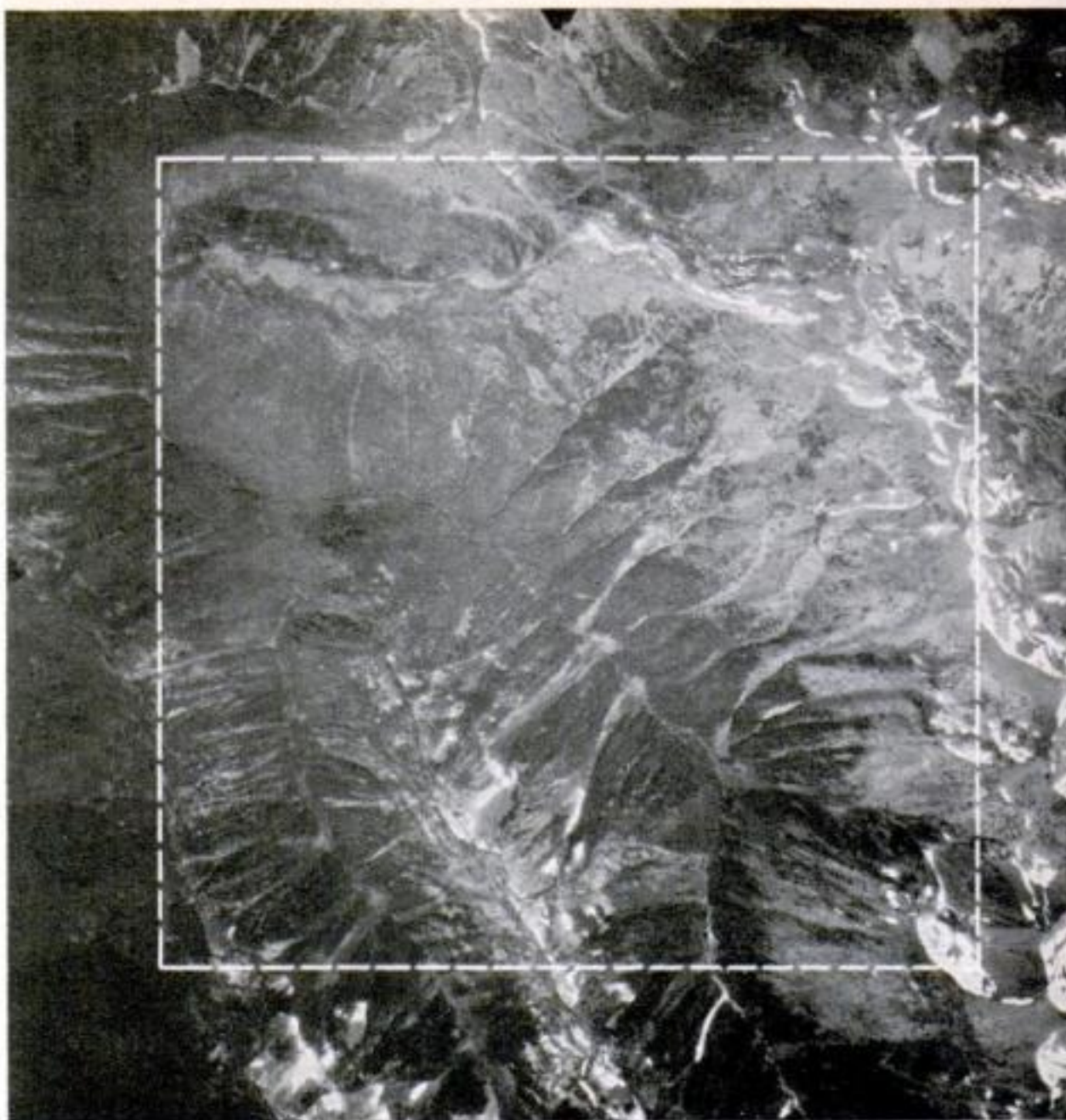
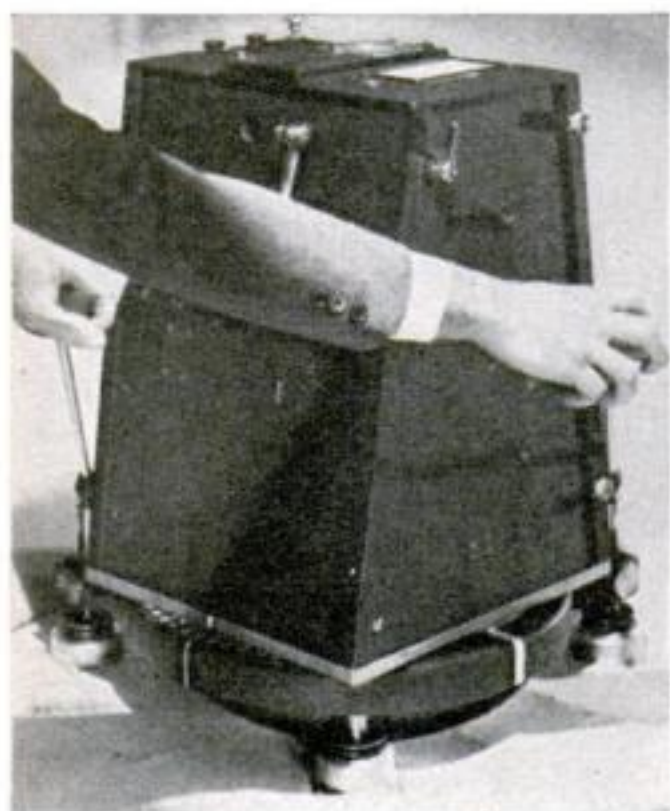
**AFIELD AND ALOFT,** rubber is defense news. At the right, horses and riders wear gas masks of rubber in a smoke-screen test at the Aberdeen Proving Ground. Below, a rubber sheath keeps ice from forming on the propeller of a combat plane. By means of grooves, a de-icing liquid is fed out along the blade. At the lower right is a waterproof, heat-retaining rubber boot developed for Army and Navy airmen







Metrogon takes in 17 degrees more than previous single-lens cameras



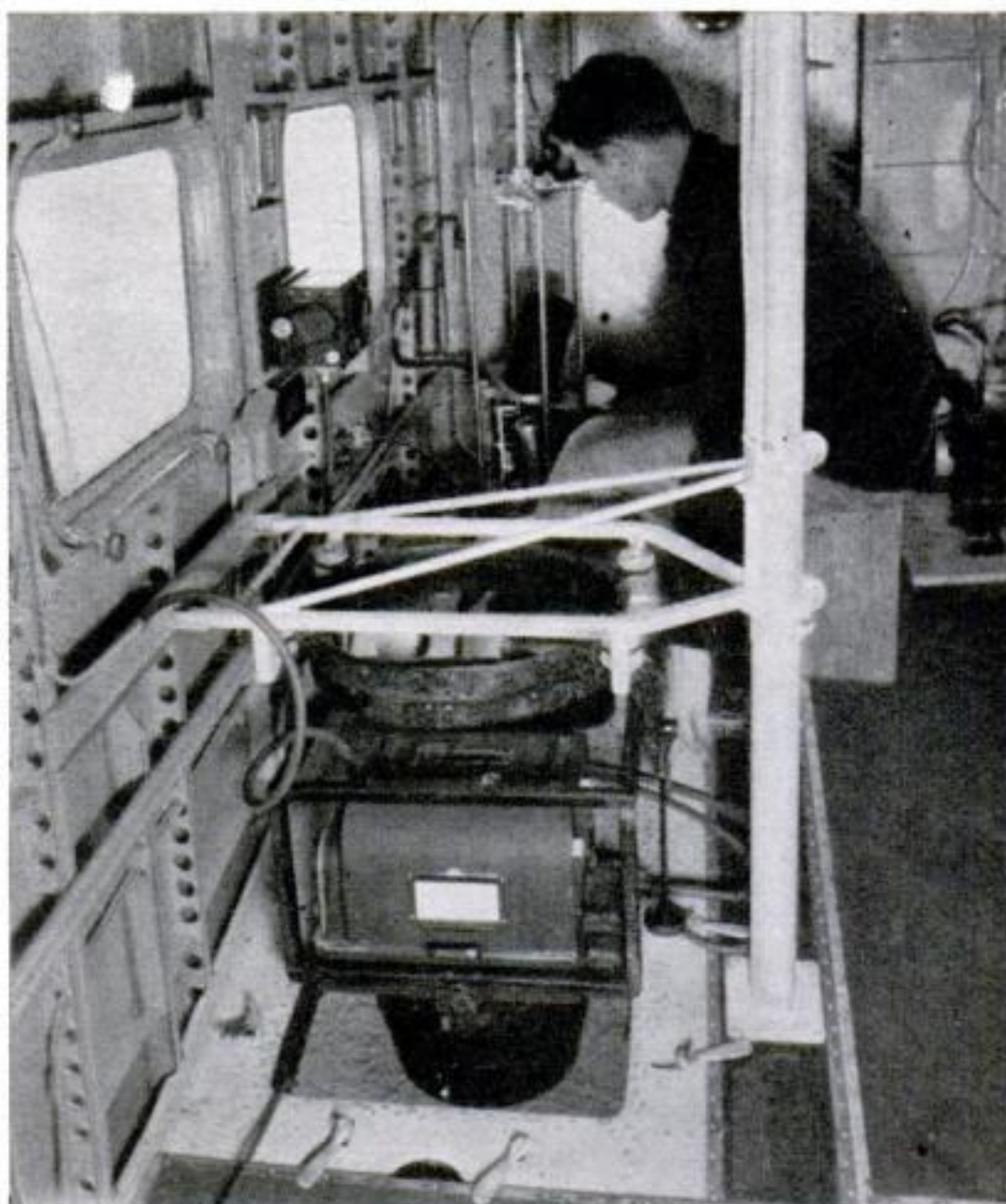
*Wallace Aerial Surveys*

A big portion of the wild Mount Olympus Peninsula, in the State of Washington. Previous lenses would take only the central part

## Lens Doubles Area Covered by Aerial Camera, Saving Time in Air Corps Mapping

VIRTUALLY doubling the area recorded at each click of a flying camera, a new wide-angle lens is saving time for U.S. Army Air Corps photographers. Known as the Metrogon, the f/6.3, six-inch focal length lens has an angle of 93 degrees, 17 degrees more than the maximum previously obtained with a one-lens aerial camera. Multi-lensed cameras cover an even greater area, but the negatives require involved after-processes in making mosaic maps. The new wide-angle lens permits lighter cameras and simpler procedure. Fewer than 100 of them have been made. Although only an inch and a half in diameter, a Metrogon lens costs as much as a light automobile.

Its use permits lighter cameras and also a simpler procedure. All controls are at or near the top of the magazine, in easy reach





## ARMY'S FLYING PHOTOGRAPHERS USE PORTABLE DARKROOM

A NEW portable darkroom, which can be carried in a plane and set up in the field, enables the Army Air Service to hand to a commanding officer a photograph of an enemy position within five minutes after the film has been dropped by parachute. This was the actual elapsed time in a number of tests made at Wright Field, Dayton, Ohio.

As the plane stops rolling, the darkroom squad unloads a light-tight tent and its equipment, most of it wrapped in a single tarpaulin. The tarpaulin is spread out, and while the tent is being erected, a collapsible water tank, developing tanks and film racks, a printer, and print-developing trays are set up, the last in a collapsible sink. A vacuum arrangement has kept water and the developing fluids cool. A compressed-air cylinder is used to blow up the ribs of the tent, to speed the operation. The darkroom squad moves in, and shuts out the light with a slide fastener.

Pictures turned out in five minutes, of course, must be wet and printed from wet negatives, so there is a minimum of arrangements for drying either film or pictures. In warfare there will be little time for that in the field. Instead, prints will be delivered wet to waiting couriers, who will dash off with them, either on motorcycles or in the new "blitz buggies."

When the darkroom has done its job, its equipment can be folded up quickly and wrapped compactly in the tarpaulin, on which it was spread while the tent was being erected.



As the plane stops rolling the darkroom squad unloads its equipment



Master Sergeant A. E. Matos spreads out his gear while the light-tight tent is erected by inflating its ribs with a compressed-air cylinder



Sergeant L. D. Vickers picks up a case containing exposed film, which was dropped by parachute, and takes it to the portable darkroom. In five minutes wet prints are produced and handed to a waiting courier





# What About the RIFLE?

**It Now Takes 1,000,000 a Year to Supply the New Friends of an Old Weapon That Has Always Been America's Favorite**

**By ROBERT E. MARTIN**

**T**HE UNITED STATES, always a nation of rifle makers and users, today is making more than ever before. At the same time it is turning out Garand semiautomatics for an Army of 1,400,000 men, it is manufactur-

ing close to a million rifles a year for civilian use. But whether a rifleman is a soldier using the Garand, or a civilian out hunting or firing at a target, his weapon stems back to a Viennese gunsmith named Gaspard Kollner.

Kollner discovered, about 1520, that by adding spiral grooves to the barrels of the old smoothbore muskets and fowling pieces he could make a gun that would shoot straighter and farther. He was applying a principle known to the crossbowmen of an earlier day, that spinning a projectile makes it fly straighter. The first guns frightened the enemy by their noise, flash, and smoke, but seldom hit him. A good crossbow could shoot with reasonable accuracy up to 400 yards, while the early smoothbores did well



A bolt-action, .22 caliber rifle, one of the most popular types for target shooting. The weapon is light enough to be handled easily by a girl, but accurate enough for use on a 200-yard range, in match shooting. It is a favorite for hunting small game



The popular Winchester Model 75 repeating rifle has a simple, easily operated bolt action. It will not fire until the bolt is all the way down. Above the man's thumb is a micrometer sight. Each "click" changes the range an inch at 100 yards

The 75 weighs eight pounds ten ounces and has a barrel 28 inches long, chambered for a .22 caliber long cartridge. The firing pin travels only two tenths of an inch when you press the trigger, thus providing quicker action than older-type guns and greater accuracy in shooting at a moving object





if they hit a man at a quarter of that distance.

The earliest guns were fired with a "slow-match," a piece of rope impregnated with saltpeter, which was carried lighted and dipped into a firing pan to discharge the gun. Originally it was held by hand. Later the matchlock provided a "cockpiece" or "serpentine" to dip the rope into the firing pan. From the firing pan a train of powder, running through a small hole, led to the charge in the breech of the gun.

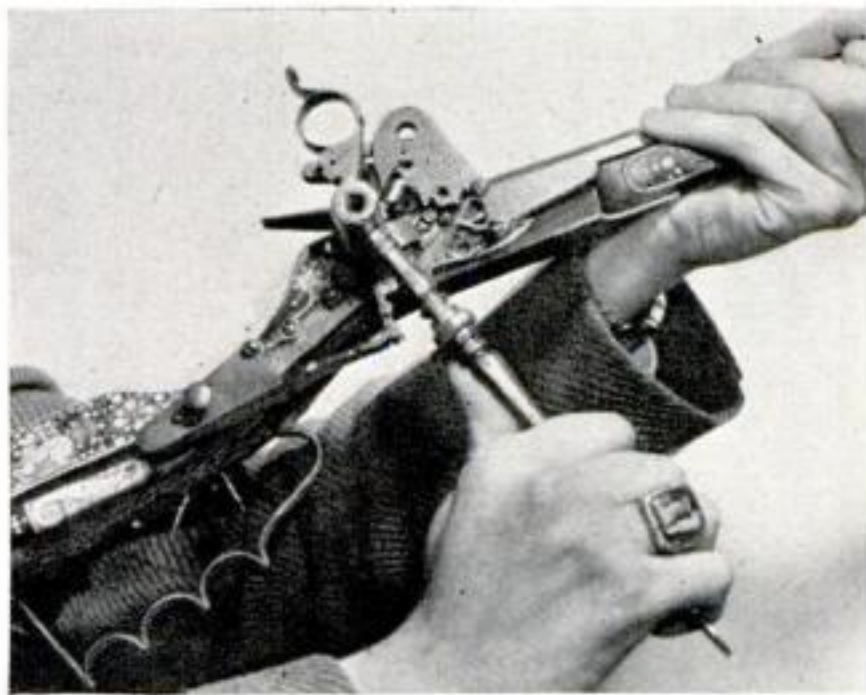
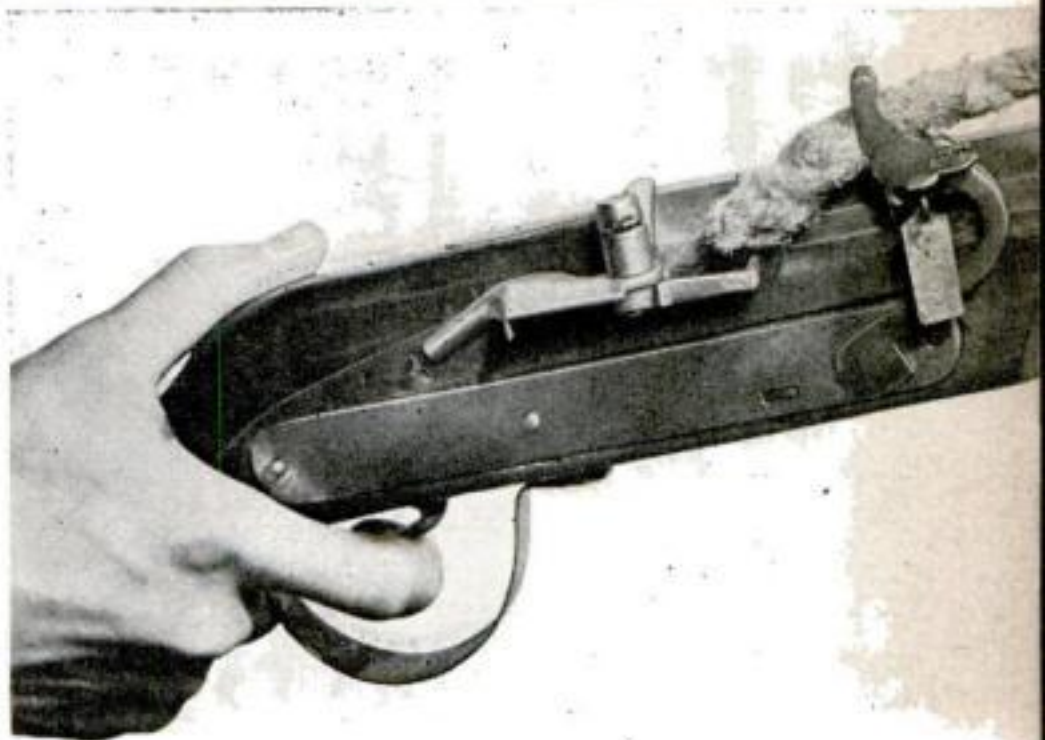
The matchlock was followed by the wheellock, in which a spring-driven, grooved wheel struck sparks from a flint, and later by the flintlock. It had a hammer much like that of a modern rifle, but instead of striking a firing pin, it carried a flint which struck sparks from a piece of steel as the hammer fell.

Until the early 1800's, these were the principal means of discharging small arms, and most hand guns were muzzle-loaders. Some of the best were the Kentucky and Pennsylvania rifles which did so much to help the early Americans win their independence.

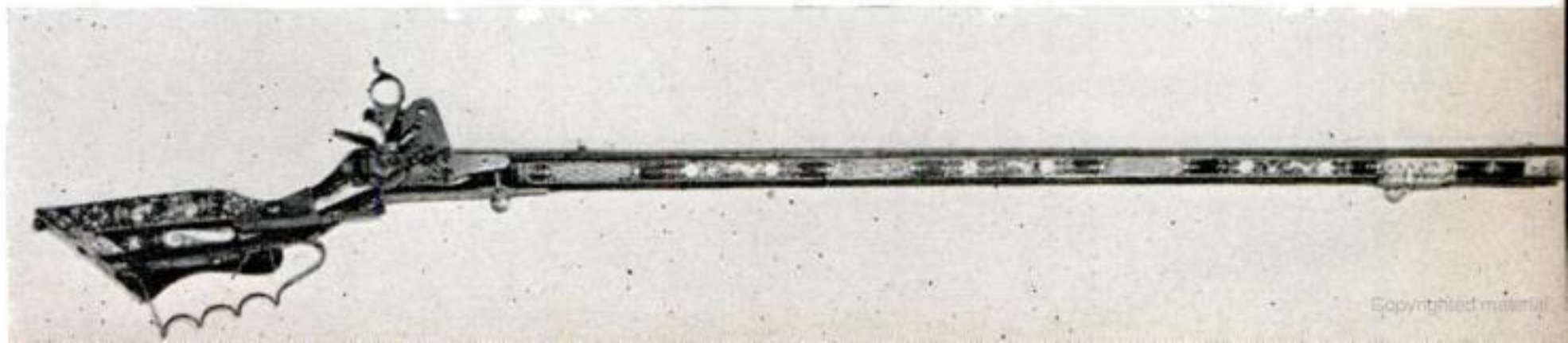
These famous rifles were only a refinement of rifles developed earlier in Europe. German and Palatine Swiss gunsmiths who had settled in Pennsylvania turned them out to meet the needs of the American pioneers. They had to be light in weight and shoot a comparatively light bullet, as a woodsman traveling on foot for days on end couldn't tote a gun as heavy as the contemporary European rifles. They had to be accurate, too, because frequently a man's life depended on bringing down game or an enemy at



The matchlock smoothbore is one of the oldest guns. The rope wrapped around it was impregnated with saltpeter. This "slow-match" was carried lighted and before the matchlock was introduced, it was dipped by hand into the firing pan to discharge the gun. The matchlock provided a serpentine to hold the match, as in the picture at the right, and also tied it mechanically to the trigger



The next refinement was the wheellock, in which a spring-driven, grooved wheel struck sparks from a flint when the trigger was pulled. The spring had to be rewound with a spanner every time it was fired, as in the picture at the left. Nevertheless, this "hind's foot" rifle was a very fancy sporting arm around 1600. It took its name from the graceful shape of the stock as seen below







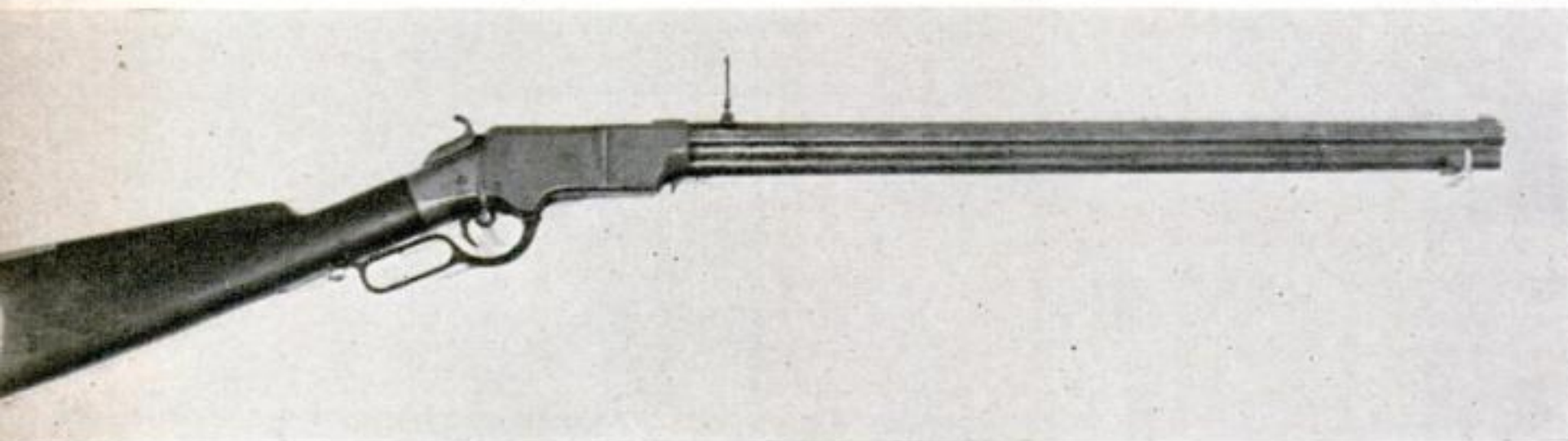
A Kentucky flintlock rifle of about 1780, with a "Roman nose" stock. The Kentucky and Pennsylvania rifles, which did so much to help win the Revolution, were as accurate as most modern guns up to 100 yards, and were effective up to 250 yards. Some were six feet long. They fired a .40 caliber bullet

At the left, cocking the Kentucky flintlock. When the hammer was released by the trigger, it struck sparks from the frizzle, a steel plate, and at the same time forced the frizzle back from the firing pan. The flintlock was a great advance, for the frizzle helped the rifleman keep his powder dry

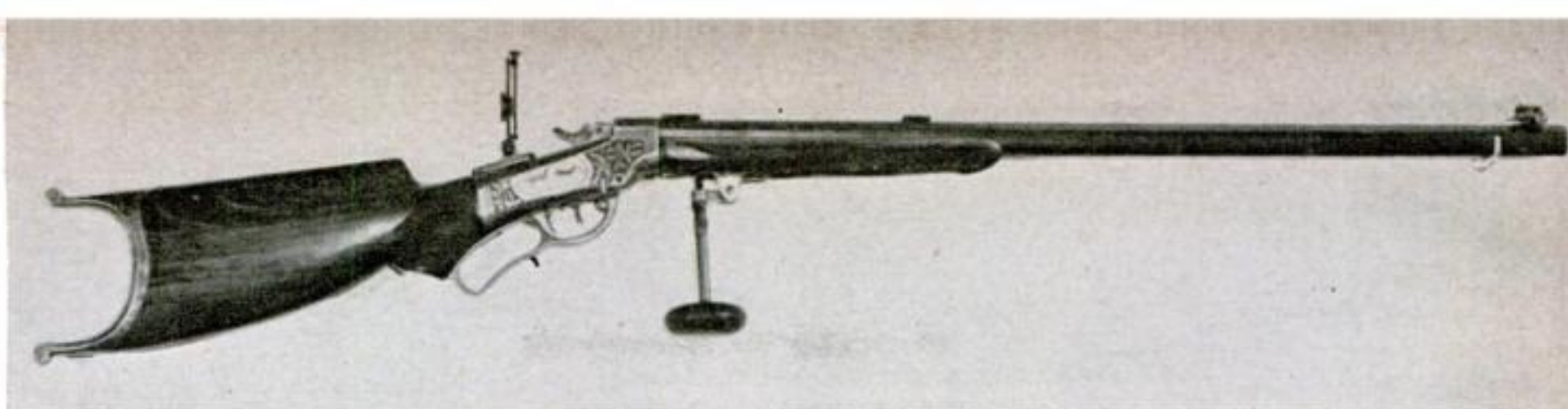
Below is the plains rifle used in the West about 1830-40. It was fired by a percussion cap, which makes it seem almost modern, but it was muzzle-loaded, with ball of 200 grains and 250 grains of powder, compared to the 125-grain bullet and variable charge used in the Kentucky rifle. The shorter barrel made it handier to use on horseback. At the right is pictured the detail of the firing mechanism, showing both the cap and nipple on which it fitted



A Henry repeating rifle, one of the first successful repeaters using metallic cartridges. This breech-loading, .44 caliber gun was popular in the West in the 1860's, 70's, and 80's. Its lever action was similar to that of modern rifles. It was the metallic cartridge that made breech-loading possible







A Schuetzen rifle made in Denver in 1890 by George Schoyen. These guns weighed from 13 to 15 pounds. Notice the fancy stock, which fitted around and under the arm, instead of against the shoulder; the tall peep-hole sight, and the palm rest

The left elbow was rested on the hip to support the palm of the left hand, holding the rest. These guns were fired from a standing position in special Schuetzen matches introduced by immigrants from Germany, where they were long popular. The game called for as much equipment as the modern small-bore shooter uses, and finally died of over-specialization, but some of the Schuetzen records still stand

long range, in the days of the old frontier.

The average Kentucky rifle had a longer barrel and a third smaller bore than its predecessors, some of the barrels being four feet long. It was about .40 caliber, fired a 125-grain bullet, with a muzzle velocity of 1,300 feet a second, and had an effective range of 250 yards. Its accuracy and range made it deadly in the Revolution and the War of 1812 against the "Brown Bess" smoothbore muskets of the Redcoats, which didn't have half the range or a quarter of the accuracy of the American weapons.

Up to 100 yards, those old rifles were as accurate as most modern guns. What they could do was demonstrated in the Battle of New Orleans. American troops, including 2,600 Kentucky and Tennessee riflemen, killed 2,100 British soldiers. The American losses were six dead and seven wounded.

Contributing greatly to the accuracy of the American rifles was the "patched" bullet. The bullet was placed on a piece of tallow-coated leather or cloth laid over the muzzle of the gun, and the whole rammed home. The bullet was slightly smaller than the bore, and the patch gave it a tight fit in the rifling. Prior to this, bullets had been made larger than the bore, and pounded down the barrel. This deformed the bullets and detracted from their accuracy.

The next step forward was the invention of the percussion cap, containing fulminate

of mercury. When the cap was struck by the hammer, the fulminate fired through a pinhole into the breech to ignite the charge. With this, hunters and soldiers no longer had to worry about keeping the powder in the firing pan dry.

This cap was developed in the early nineteenth century, but was slow to be adopted. The development which really made possible our modern rifles was the metallic cartridge, first made successfully by Smith & Wesson in 1856.

Up to that time "cartridges" had been cloth or paper containers in which the bullet and a measured charge of powder were carried. To load the weapon, the cartridge was opened, the powder poured down the barrel, and the bullet rammed after it.

With the metallic cartridge, it was possible for the first time to make successful breech-loading and repeating rifles. Though only a few were used in the Civil War, most of the troops fighting with percussion or flintlock muzzle-loaders, their superiority was so marked that after the war they quickly replaced the older styles.

Then came a long series of rifles that became famous as Americans pushed westward. Sharps, Remingtons, Henrys, and Winchesters were some of the more popular ones. Since those days there have been few basic changes, though there have been





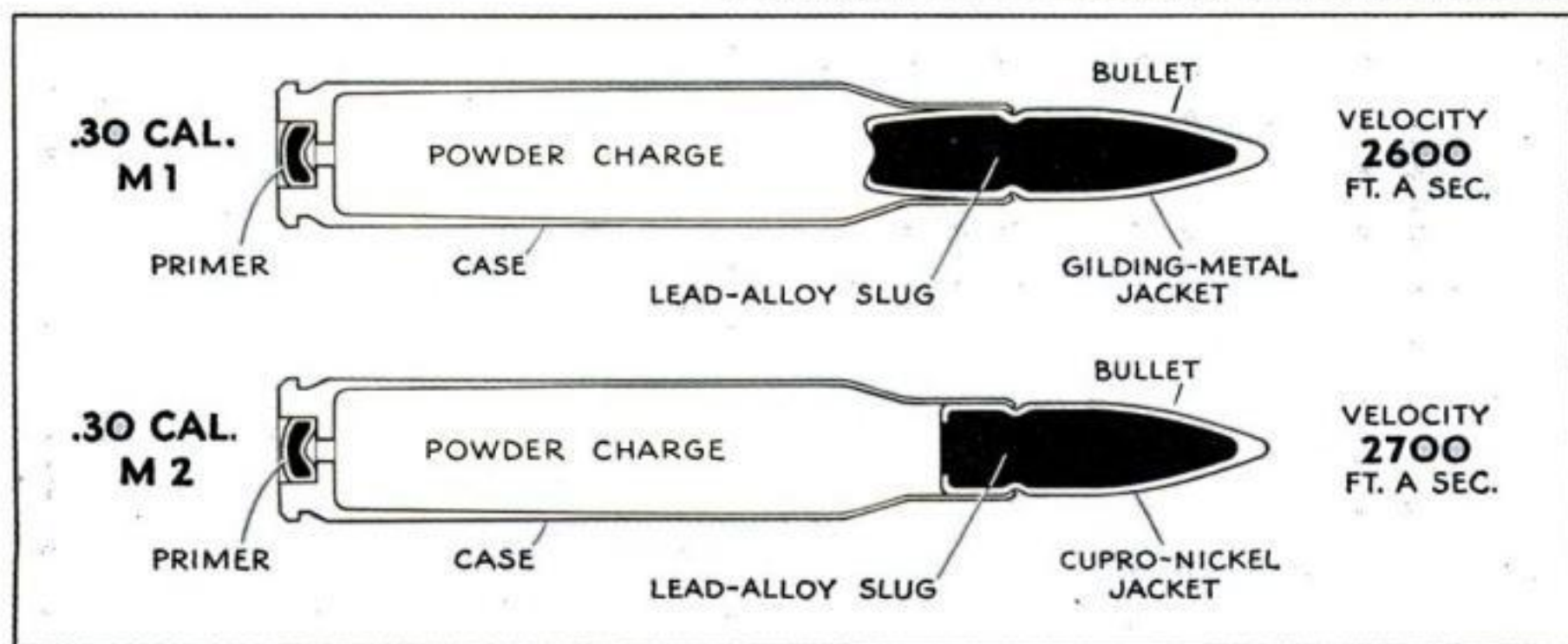
These are all modern .22 caliber rifle bullets! The first four can be fired from the same gun, and are used chiefly in target shooting. On the extreme right is the .220 Swift, which has a muzzle velocity of 4,140 feet a second, considerably more than the 2,700 of the Army's new Garand rifle



An old-time powder horn. The bullets and charges, reading from left to right, are for the matchlock, wheellock, Kentucky flintlock, plains, Henry, the 32-40 Schuetzen, .220 Swift, and the so-called .22 long rifle



Cartridges were originally sacks of cloth or paper, each containing a bullet and a measured charge of powder. For loading, the cartridge was torn open, the powder poured down the barrel, and the bullet rammed home. Compare the two modern American .30 caliber military cartridges below, the M 1 for the Garand, the M 2 for the Springfield







Adolph Topperwein, of San Antonio, Texas, who has been called the world's greatest trick shot. In continuous firing he once hit 14,540 flying targets—2½-inch wooden cubes tossed into the air by an assistant—without a miss, to establish a record that remains unbroken to this day



Metal disks and similar targets pierced by Topperwein while they were flying through the air. Many of them are the size of half dollars, and some are even smaller. Topperwein, who gave up art for shooting, still does a little drawing, outlining Buffalo Bill on tin with bullets

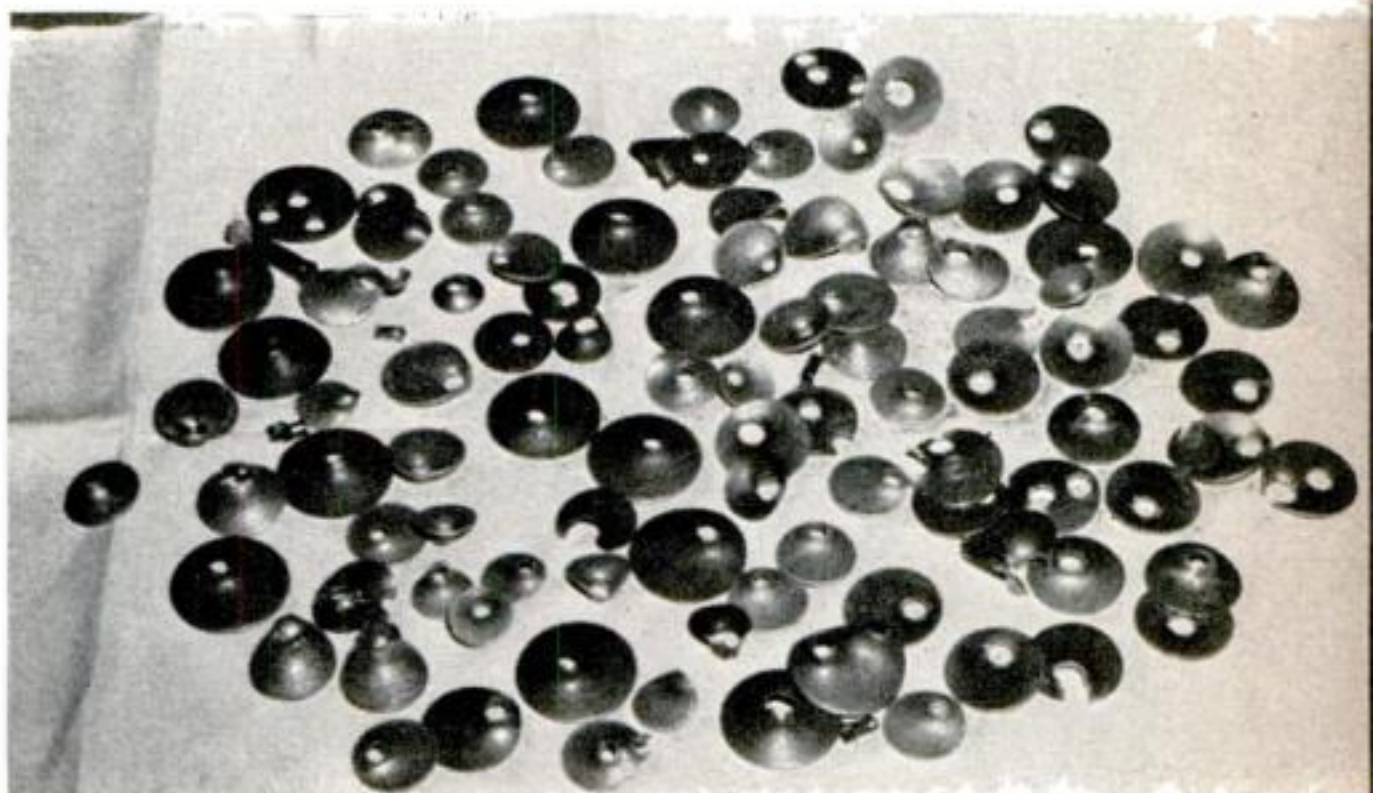
steady improvements in powders and projectiles.

The old Winchester 1866 Model, for instance, the first Winchester to bear the name, fired a .44 caliber bullet with a muzzle velocity of 1,100 feet a second. It had a modern lever-action breech mechanism, and held 15 rounds in the magazine.

Some of these old-timers are still in use, and parts for them can still be purchased.

A modern Springfield or Garand service rifle is only .30 caliber, but fires its 175- to 150-grain bullet with a muzzle velocity of 2,700 feet a second, and has an effective range of 1,000 yards or more. The Winchester bullet was almost three times as heavy, but its range was well under 1,000 yards.

A conservative estimate places the number of riflemen and women who concentrate on target shooting at 500,000, and the number is growing fast. Five years ago there



were only 42 matches sponsored by the National Rifle Association of America, but last year there were 298 and now there are more rifle ranges in the nation than there are golf courses, if you exclude municipally owned links! Besides the target shooters, there are thousands of gunners who like to punch holes in tin cans stuck on fences. And the country has 7,000,000 licensed hunters, many of whom can qualify as expert riflemen. Thus a growing number of citizens are carrying on the American tradition of knowing how to use a gun, whether they'll ever need to or not.





These four electric eyes, set an inch apart, give the jumper credit for jumps above the set mark. Another advantage is that the light beams do not sag as do the usual bamboo poles



## Electric Eyes Speed Up High Jump by Measuring Mark Set Exactly

THE ELECTRIC EYE was used to speed up high-jumping at a recent track meet of the Schenectady, N. Y., Patrolmen's Association, by measuring the height of each jump exactly, almost regardless of the height of the pole. The equipment, designed by General Electric engineers, comprises a movable light source on one standard and four electric eyes on the other, with a box which operates the equipment and records the height

jumped. Four parallel beams, an inch apart, are focused between the standards, so that if a jumper goes higher than the set mark, he is credited with the additional height up to three inches. In place of the usual bamboo pole, a narrow strip of paper is stretched along the path of the lowest beam to guide the jumper. The Amateur Athletic Union, under whose auspices the meet was held, approved the equipment.

## Device Spins Airplane Wheels at the Speed Ship is Landing

CHARLES H. ROBERTS, Burbank, Calif., inventor, has perfected an apparatus to spin airplane wheels at the same rate at which the plane is landing. At present, sparks and big chunks of rubber fly from the tires when big transport planes land at high speeds, with their landing wheels stationary. The tires cost around \$145 each, and because of the "dead-wheel" landings, last for only a few trips. If the tires are turning they are less likely to blow out, just as there is less jar when a man lands running when he leaps from a moving vehicle instead of jumping with his legs rigid. Robert's apparatus weighs only 24 pounds, and is powered with a two-horsepower hydraulic motor, high-compression fluid being the motive force. In the picture he is holding a hub cap which fits over the device to protect it against damage.



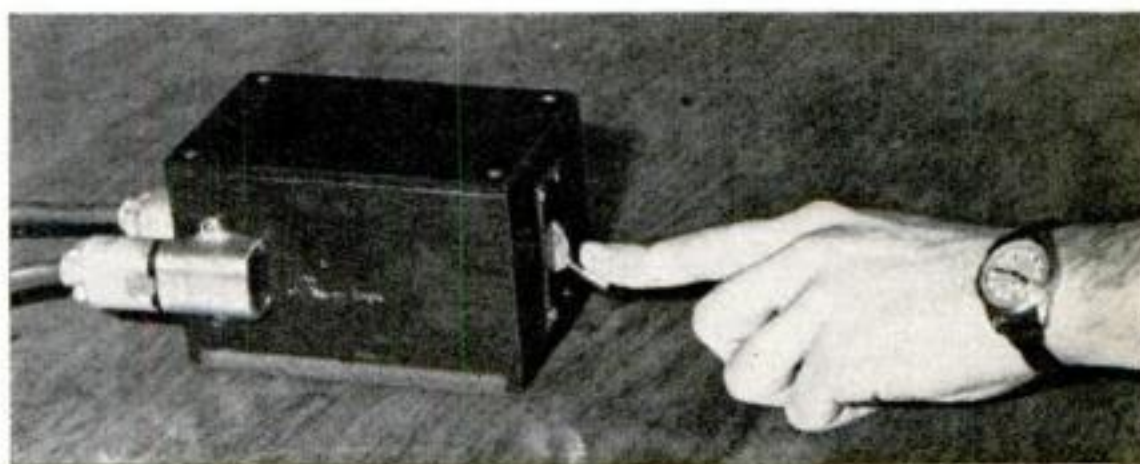


## Coughing Announcer Punches a Button to Avoid Blasting Mike

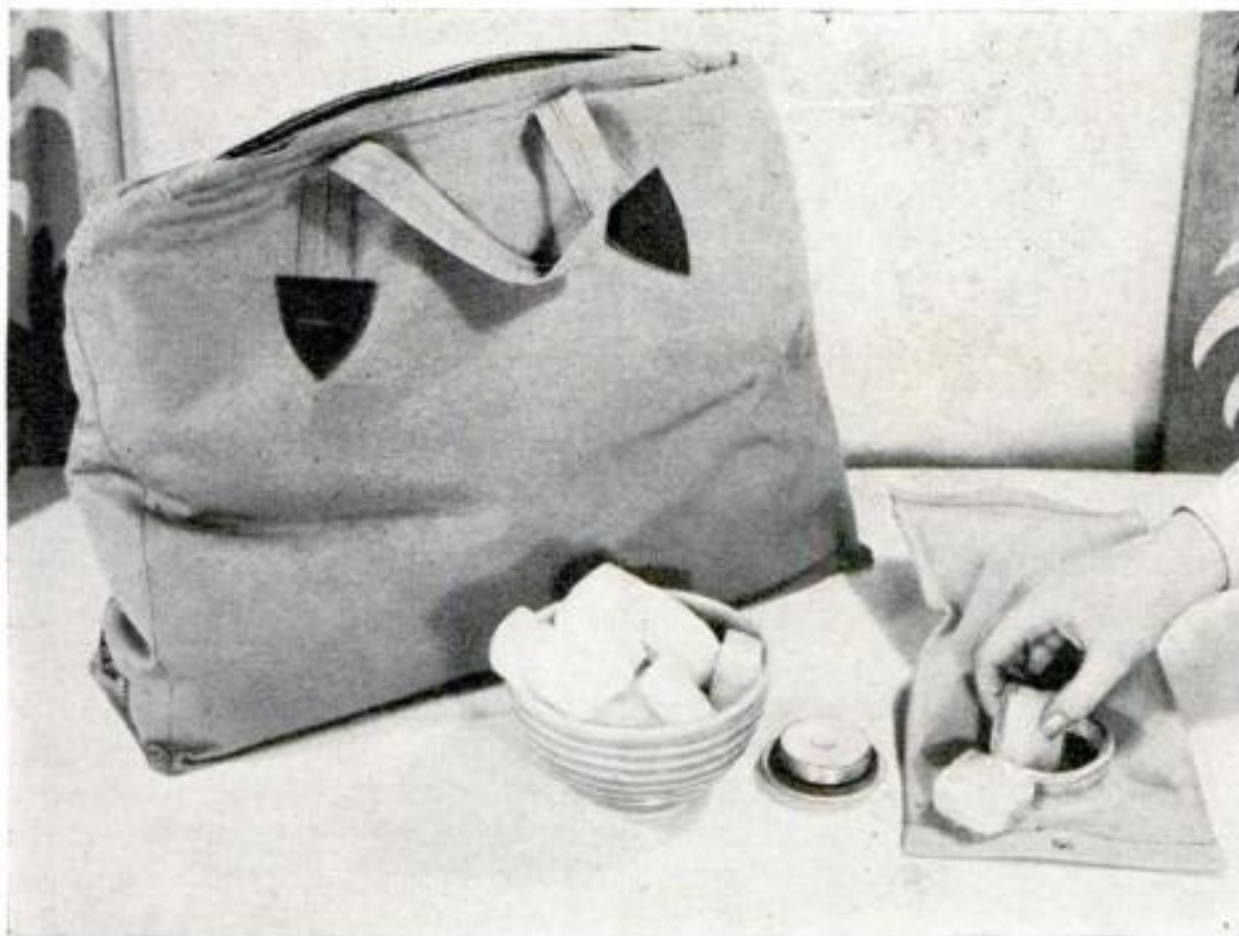
A "COUGH BUTTON" has been invented by engineers of Radio Station WOR, in New York City, to make their work easier. Heretofore when a performer or newscaster felt a cough coming on, he waved his hands wildly to signal to the engineer in the control room to cut him off the air. Naturally the engineers found it difficult to time the exact moment of the cough, so it often blasted forth over the air. They figured the cougher could time his own cough much more easily, so now a little black box is always handy, carrying a button the announcer, news analyst, or performer can push and cut himself off the air long enough to clear his throat, and there is no further need for frantic waving to the engineer in the control room. In the photograph at the right, Raymond Gram Swing, noted news commentator, is using the device.



Raymond Gram Swing and other speakers over WOR, in New York City, broadcast with this black box handy. When they feel a cough is coming on, they punch the button and cut themselves off the air.



## Portable Ice Box Made of Cloth Is as Flexible as a Beach Bag



A PORTABLE ice box made of cloth is on the market. It is as collapsible and flexible as a beach bag, yet its insulating properties are excellent. The bag is designed for use with either dry ice or ice cubes. A pound of dry ice will keep food at from 40 to 50 degrees Fahrenheit for 24 hours when the outside temperature is from 70 to 75 degrees. A tray of ice cubes will do the same thing for 12 hours. Double-lined for easy cleaning, the bag is designed for picnic parties and outdoorsmen.





Three of the Jonas one-tenth-size scale models—a buck, doe, and fawn

# ANIMALS of the WORLD MODELED BY SCULPTOR



The railroad station he has turned into a studio. Below, he models a bison



**A**N ABANDONED railway station at Lake Mahopac, N. Y., is being turned into a modern Noah's ark by the wild-life sculptor, Louis Paul Jonas. Using the waiting room as a modeling studio, the ticket-agent's compartment as an office, and the baggage room as a storehouse, he is reproducing, at one-tenth natural size, all the animals of the world.

Jonas has 75 different species completed. Besides most of the North American game animals, they include such unusual foreign species as the oryx, the ovis poli, the eland, the takin, the impalla, the koodoo and the dik-dik. The dik-dik model weighs less than a pound. It is the lightest. The heaviest is the African bull elephant, 12 pounds. The

POPULAR SCIENCE





Just a few of the animals in Jonas' ark. He expects to do all the animals in the world during the next ten years. All are scientifically exact as well as artistic, and so are widely adopted for use by museums and schools as natural-history study material



Jonas and his son, Paul, at work in the studio. Paul is wearing a mask to keep the plastic dust out of his mouth and eyes while he smooths down the 20-inch figure of the giraffe with an electric hand grinder. Models are of plastic molded with compressed air

giraffe model, 20 inches high, is the tallest, while the African klipspringer, only three inches high, is the shortest.

Because the models are both artistic and scientifically exact, they are being widely adopted for museum display. Yale University's Peabody Museum recently ordered 15. Other museums featuring them include the Academy of Natural Sciences of Philadelphia; the Buffalo, N. Y., Museum of Science and Industry, and the California Academy of Natural Sciences, in San Francisco. For schoolroom use, Jonas has prepared a number of miniature habitat displays in which his models are shown before painted backgrounds and accompanied by a reproduction of the animal's footprint, a bit of its hide, and photographs of it in the wild.

It takes the sculptor two weeks to finish a model, not counting research. The first model is prepared in clay. From this, Jonas produces a plaster mold and casts the final model by forcing plastic material into the mold with compressed air. The final steps are smoothing up the model with an electric abrasion tool, putting on a sizing of aluminum paint, then applying oil colors for the realistic exterior. Finished models, any number of which can be cast from the master mold, sell for from \$10 to \$45.



The sculptor shows off one of the miniature habitats he supplies to schools to go with his models. Immediately in front of the box is a reproduction of the animal's footprint and a bit of its hide, together with a dozen pictures of it in the wild



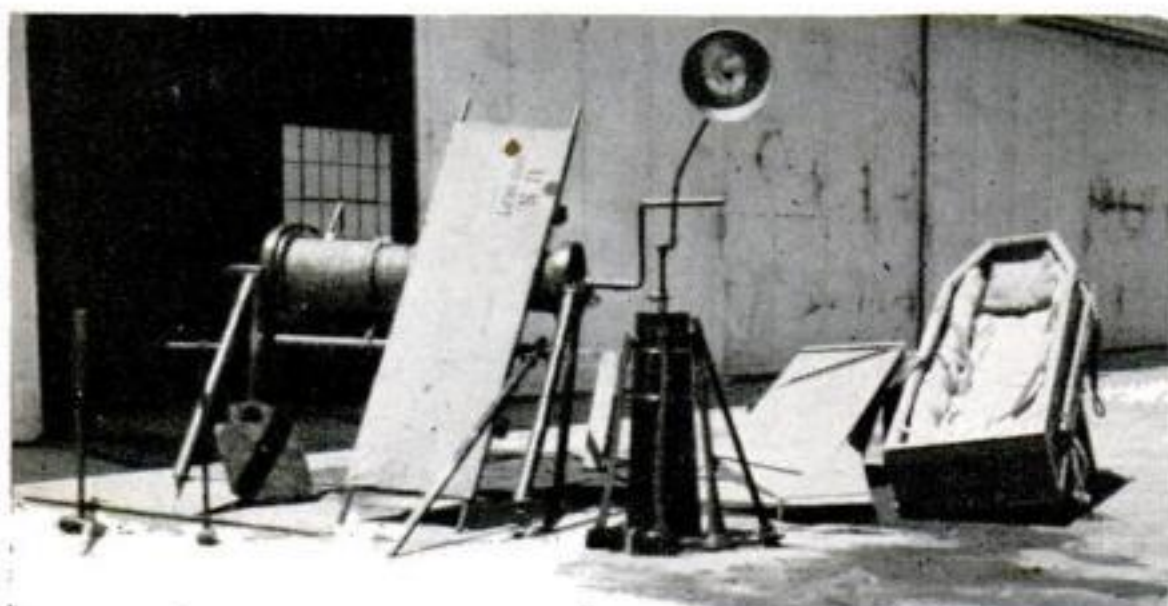


## Underwater Seat Supplies Fresh Air to Bathers

A PARKING STATION for underwater swimmers has been installed at Wakulla Springs, Fla., where bathers can sit and admire the wonders of marine life without having to "come up for air." The air is pumped to the sedan-chairlike device resting on the bottom. Swimmers dive down and head through its open sides. When they sit down, their heads are above the surface of the water in a pocket of trapped air. A transparent top of Lucite gives a clear view of surrounding objects. Swimming coaches use it for watching pupils.

## "Mercy Sled" Hauls Crash Victims Back up Steep Mountain Slopes

CALLED a "mercy sled," a sturdy padded box designed and built by maintenance engineers of the California State Division of Highways has already done valuable rescue service for victims of highway accidents in the hills of several mountainous counties. The need for the sled became apparent after accidents in which badly injured motorists had to be brought back up steep, rocky slopes to the highway. The mercy sled now may be lowered by rope and windlass and hauled back up with an accident victim strapped upon its soft mattress.



Lined with a soft mattress, the wooden sled gives support to the badly injured as it is drawn up a hillside by the windlass at left



## Small Motorboats are Molded of Phenolic Resin Plywood



This baby motorboat seats six persons and has room under the deck for lunch baskets and fishing gear

SMALL motorboats are being molded of phenolic resin-glued plywood under the Vidal process. They are powered with a Crosley water-cooled, electric-starting, ten-horsepower marine engine, and have seats for six adults with room under the deck for lunch baskets, fishing gear, and bathing

suits. The boats are designed to ride comparatively high in the water, and are protected from excessive splash by full-length splash rails. Operation is economical, the gasoline consumption being only half a gallon an hour at cruising speed and a gallon at full throttle.

## Mobile Substation Restores Power If Regular One Fails

A MOBILE substation has been built by Westinghouse for the Cincinnati Gas & Electric Company. It is essentially a transformer, which can reduce the voltage of high lines to usable stages for factories and homes if a regular substation fails. Thus if the lights go out from trouble in a regular substation, the company can send a trailer unit to the area at 40 miles an hour to "plug in" and restore the power.



The mobile substation is a transformer that can travel 40 miles an hour



# Static Electricity Filters the Air in Up-to-the-Minute Office Building

**D**ECLARED the world's most up-to-the-minute office building, an ultramodern structure 300 feet long, 120 feet wide, and three stories high has just been completed near Philadelphia, Pa., for some 700 workers of the Westinghouse Electric and Manufacturing Company.

Fresh air, drawn into the building by two fans at the rate of 130,000 cubic feet every minute, passes through a pair of electrostatic air cleaners of latest design. These remove up to 90 percent of dust, soot, smoke, and other air-borne particles. Then the cleaned air passes over warming or cooling coils on its way to the rooms, where thermostats control its temperature. It finally returns through wall grilles for recirculation. To form a barrier to summer heat, the roof is covered with an artificial lake of water, two to three inches deep, which will cool the surface by evaporation under the sun's rays.

Fluorescent lamps totaling three miles in length provide glareless, high-intensity illumination. They consume about 200 kilowatts of electric power, or hardly more than one fourth of the amount that would be needed for incandescent lamps.

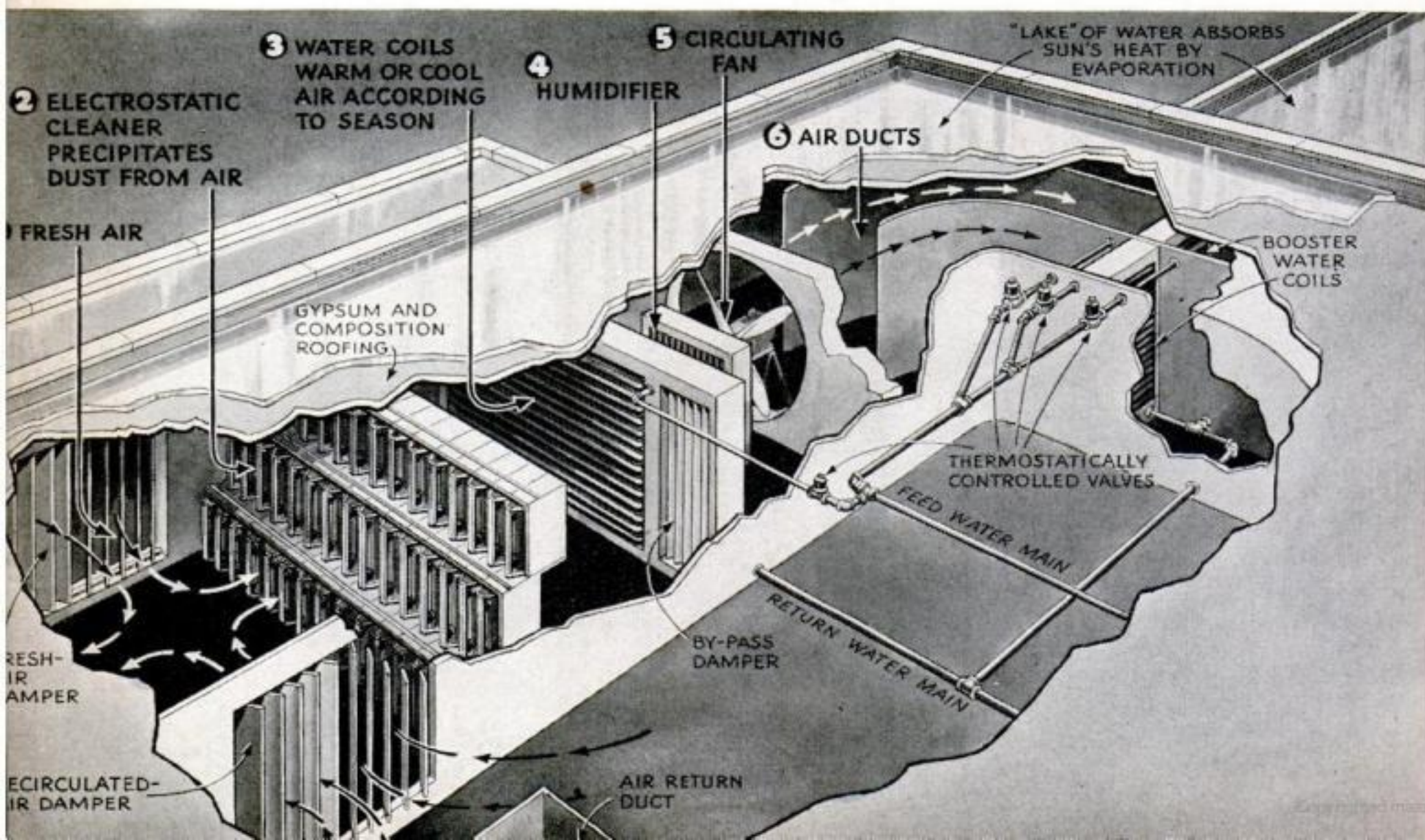
Soundproofing completely kills noise throughout the plant. Asphalt tile covers the concrete floors, and perforated pans in the ceilings contain rock wool, to make con-

centration easy for the workers by deadening stray sounds.

Windows of unique design consist of translucent glass blocks, with the exception of one clear section at the center of each. This double-walled clear pane, called by construction engineers an "island window," allows the workers to look outdoors and prevents a shut-in feeling.

First-floor design includes a fireproof kitchen and cafeteria, a blueprint room, a tracing vault, and a photographic room. The second floor, occupied exclusively by the engineering department, has the longest unobstructed drafting room in any industrial plant—300 feet long and 100 feet wide. Here drawings are made of the huge land and marine turbines that will be turned out by near-by shops, mostly on Government order. A dumb-waiter speedily delivers the drawings between this room and the tracing vault downstairs. On the third floor, an auditorium seats 500 persons comfortably.

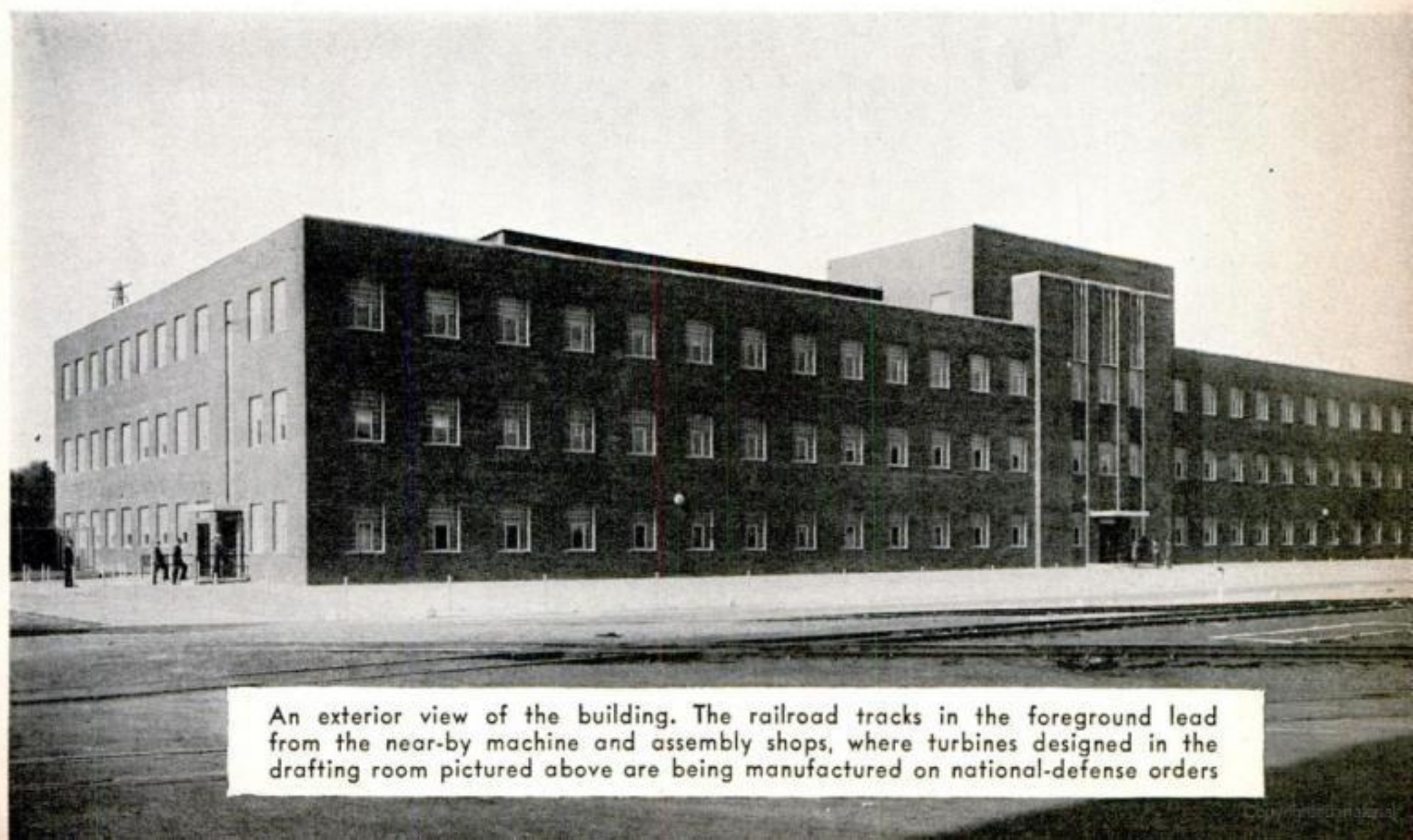
Within the three-story brick-and-tile building, the Westinghouse staff perform their duties undisturbed, in the midst of massive assembly and machine shops of the South Philadelphia works. Without necessity of leaving the building during working hours, and shut off from noises inside and out, the office worker goes through the day unmindful of the bustle about him.





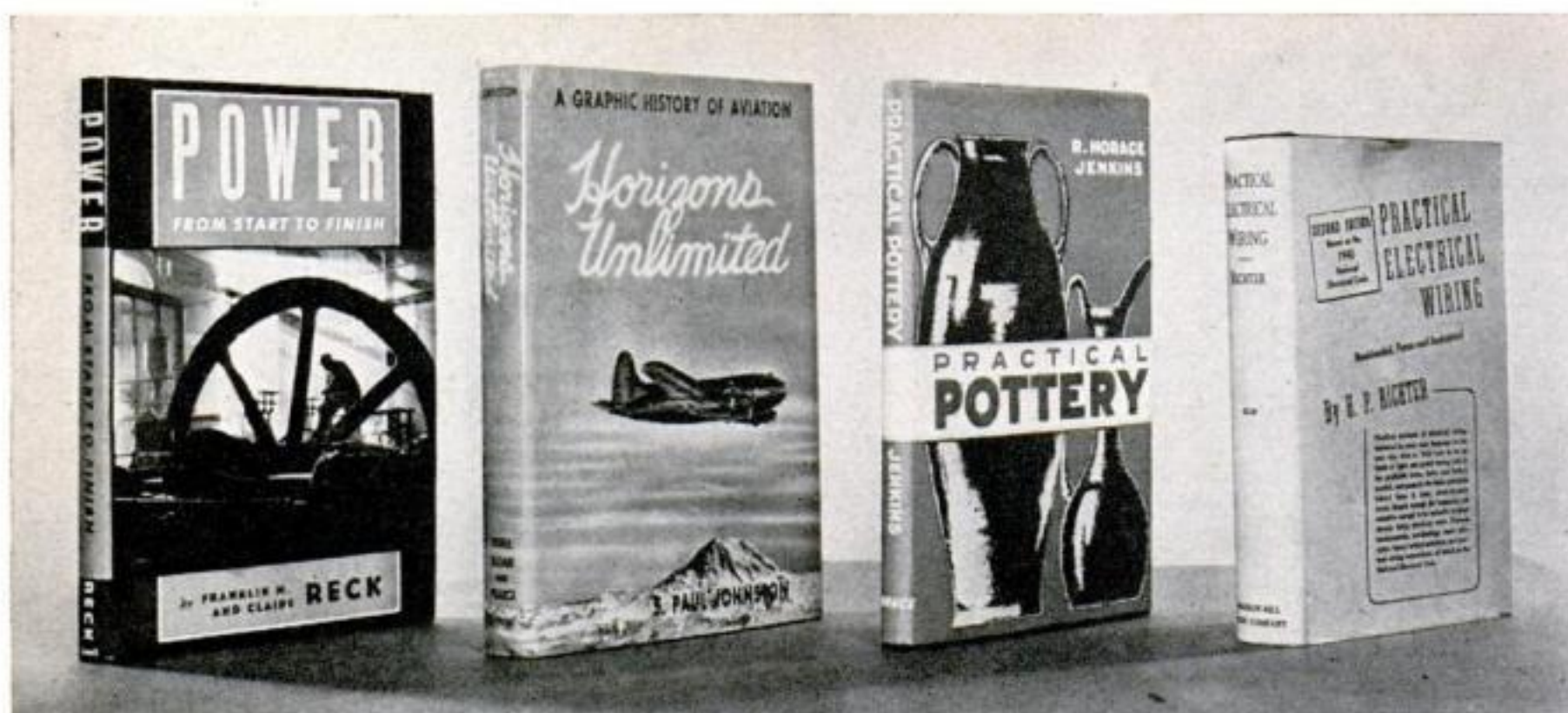


Forty feet above the ground, on the roof of the new office building of the Westinghouse Steam Division, at Lester, Pa., a three-inch-deep lake holding 70,000 gallons of water sheds the heat of the sun's rays in the hot months. Another remarkable feature of the building is the longest unobstructed drafting room in any industrial plant. Seen at the right, this room measures 300 by 100 feet and is lighted by  $1\frac{1}{2}$  miles of continuous-strip "daylight" fluorescent lamps. Some 300 engineers, draftsmen, and clerks, out of the 700-odd occupants of the building, work in this room. In connection with its complete air-conditioning plant, the wonder structure has electrostatic air-cleaning equipment illustrated in the drawing on the opposite page



An exterior view of the building. The railroad tracks in the foreground lead from the near-by machine and assembly shops, where turbines designed in the drafting room pictured above are being manufactured on national-defense orders





### HOW WE USE THE SUN'S ENERGY

Power, whether man or machine-made, originates in the sun's energy. How men, past and present, have tamed this energy for the advancement of civilization is the subject of "Power, from Start to Finish," by Franklin M. and Claire Reck (Thomas Y. Crowell Company, \$2). Photographs and drawings add interest.

### FLYING—FROM THE GROUND UP

"Horizons Unlimited," (Duell, Sloan & Pearce, \$3.75) is a history of flying machines and flying men, from the early dreamers to the fighting pilots of today. Its author, S. Paul Johnston, should know his subject, as he is coordinator of research for the National Advisory Committee for Aeronautics. Text and pictures fill 354 pages.

### POTTERY MAKING AS A PASTIME

One of the oldest of the arts, pottery making as a hobby can be both inexpensive and entertaining. In "Practical Pottery," (Bruce Publishing Company, \$2.75) R. H. Jenkins tells in detail how to go about it. Instructions and working drawings for making pottery tools and a chapter of general pottery information are included.

### BOOK ON WIRING GIVES NEW CODE

Based on the 1940 National Electrical Code, the second edition of "Practical Electrical Wiring," by H. P. Richter (McGraw-Hill Book Co., \$3) is designed as a handbook for the man who actually does the work. Separate sections treat theory and basic principles, residential and farm wiring, and non-residential projects

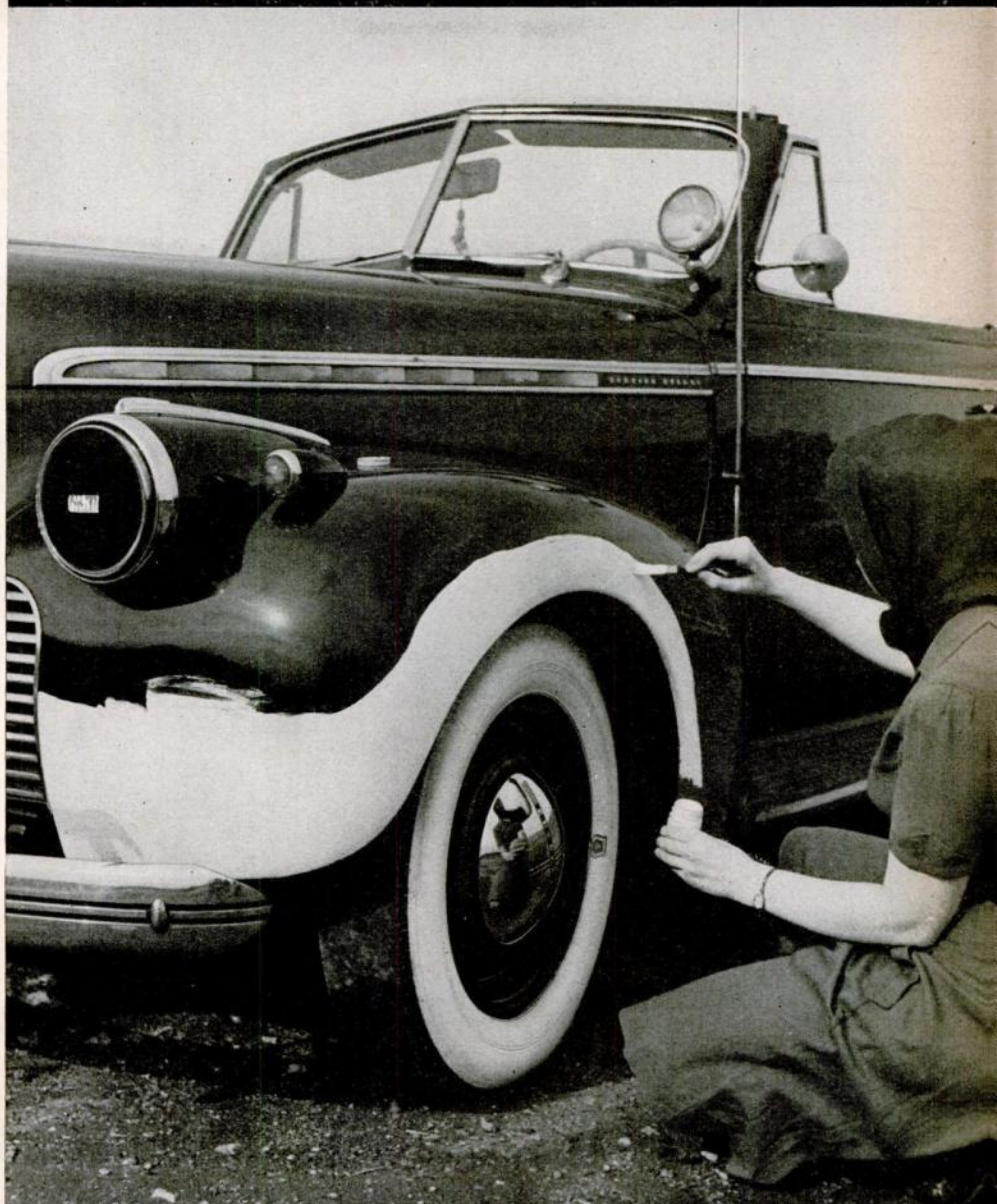
## Question Bee

How much do you know about the machines and policies that figure in national defense? Answers on page 212

- 1 A boom tender is (a) a member of the crew of a big coast-defense gun (b) a vessel employed in protecting harbors by nets (c) the helmsman of a converted yacht.
- 2 Reinterpreting an old treaty, the U. S. and Canada have agreed to (a) occupy Madagascar (b) build war vessels on the Great Lakes (c) destroy Niagara Falls.
- 3 A multiple pom-pom is (a) a military emblem (b) a signal rocket (c) a rapid-fire anti-aircraft gun.
- 4 The British battleship *Dreadnought*, launched in 1906, set the style for (a) all-big-gun main armament. (b) turrets arranged along the center line of the ship.
- 5 Depth charges are used to (a) attack underground storage depots (b) sink submarines (c) take soundings.
- 6 A balloon barrage consists of (a) bombs dropped from balloons (b) an airplane attack upon balloons (c) balloons trailing cables to snare aircraft.
- 7 A de-gaussing girdle (a) is worn by overweight officers (b) guards a ship against magnetic mines (c) protects a desert camp.
- 8 Those things that look like clock faces, up on the masts of battleships, are used to (a) synchronize all chronometers before an engagement (b) communicate battle ranges (c) show the ammunition remaining.
- 9 You would use paravanes to (a) learn to swim (b) steer a parachute (c) sweep mines.
- 10 The Monroe Doctrine was upheld by a joint resolution of Congress (a) during the Spanish-American War (b) in 1941.



# AUTOS



**How to Drive in a Blackout**

(NEXT PAGE)





## Americans Learn Safety Rules for Handling Cars in the Dark

By BERT ANDREWS

**B**LACKOUT driving has cost thousands of lives in countries abroad where there isn't one automobile to every hundred inhabitants. It would take many times that toll if blackouts were suddenly decreed in this nation, which has one automobile to every four persons.

That's why groups of foresighted men and women in many parts of the United States are striving to learn—by actual experience—the arduous rules that must be obeyed by motorists when no headlights show the way and no street lights illumine the road.

There are equally rigorous regulations for walking in a blackout, since traffic moving in almost complete darkness is particularly hazardous for the uninformed pedestrian.

Ready for a lesson in blackout driving. Light comes from left headlamp only. White tape outlines car body

Take a trip with one of the volunteer organizations that are trying to acquire advance knowledge of what to do if the lights go out.

It's a guaranteed cure for the skepticism of the overconfident autoist who says, "Why, blackout driving wouldn't bother me."

Mrs. Blanche Wolman, London-born wife of an American and formerly a member of the London Ambulance Service, is the instructor. The place is a quiet dirt road near Suffern, N. Y., but the scene is being duplicated nightly in communities from Maine to California. There is no moon. A few stars light the heavens, but not the highways.

Ten carloads of volunteers await the word from Mrs. Wolman. She is not interested now in the specialized task of ambulance driving, but only in telling the ordinary private automobile operator what to do if he has to drive in a blackout. Doctors and deb-



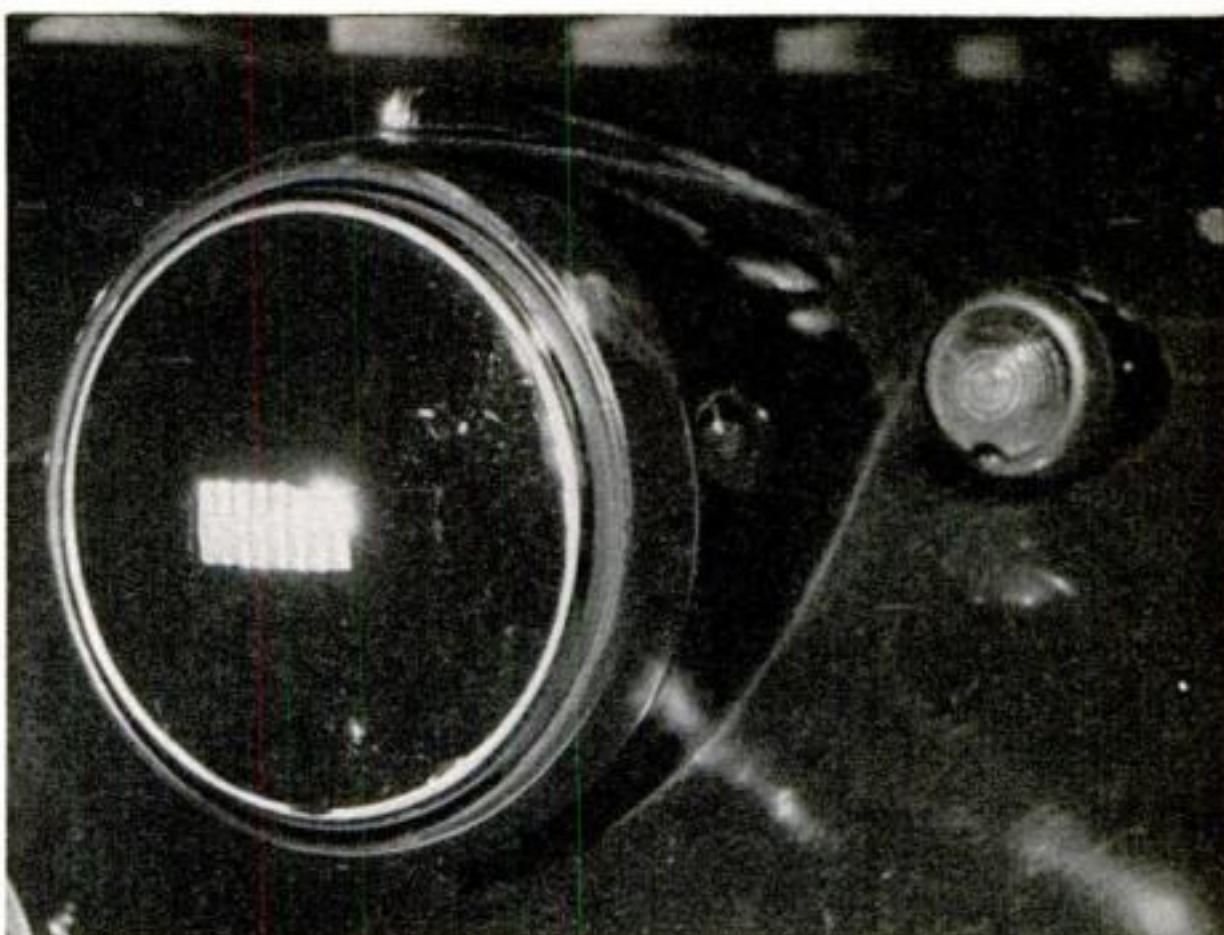
utantes, defense workers and lawyers, are her pupils.

They first learn Rule 1, which takes in the many things that must be done to prepare a car for black-out maneuvering. Here are the subsections:

Light should come from only one headlamp of your car. In the United States, where traffic keeps to the right, that would be the left headlamp. Why the left? Well, that gives on-coming traffic a warning beacon and saves many a collision and many a fender. A seven-watt bulb should be installed in that left headlamp. The glass should be covered except for an aperture two inches by one inch—covered by black cloth or black paint thick enough to let no other light shine through. Your rear light should be cowed so that the dim red glow spreads downward. As an added safeguard, your car should be striped with white paint or white tape—say about two inches wide. The stripe can run horizontally around the lower part of the car, with additional crisscrossing at the front and rear—the front crisscross to aid pedestrians or cars coming in the opposite direction; the one at the rear to enable cars behind to spot your car.

The cars of Mrs. Wolman's class are prepared in makeshift fashion to comply with Rule 1. The pupils listen to Rule 2: "Assume that you're driving along with both headlamps on," Mrs. Wolman says. "The blackout signal sounds. At the first sound switch off your lights. Stop your car. Get your eyes adjusted to the darkness. Now turn on your black-out lights."

The class obeys. The result is an eerie sight. You sit there, knowing you are one of numerous shadowy

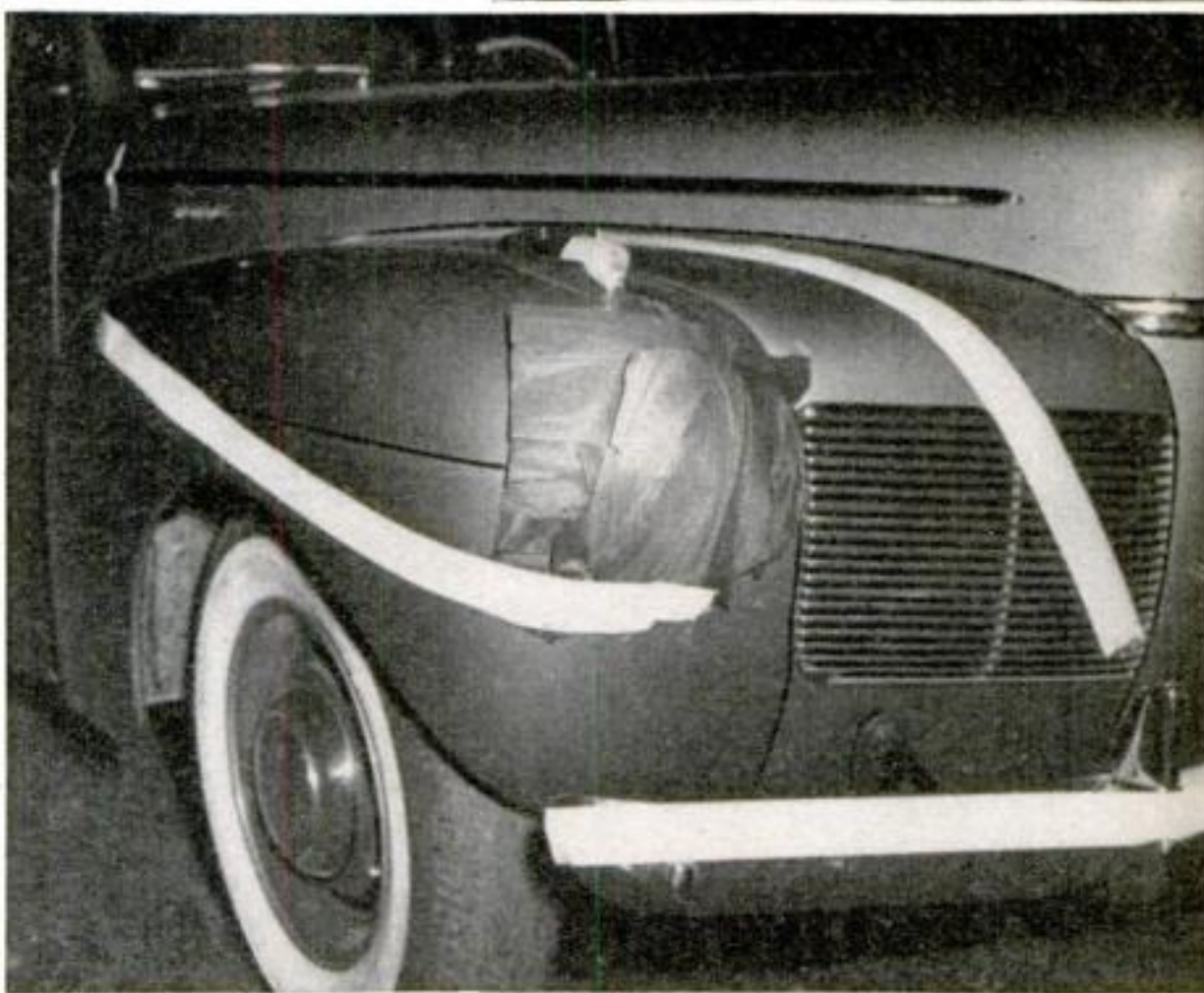


Left headlamp is equipped with a seven-watt bulb and its glass is blacked out except for an opening . . .

. . . one inch high and two inches wide. Located just a little below the center, it throws light downward



The right headlamp is completely hooded with black cloth. For more permanent treatment, paint is used





figures sitting within shadowy blurs that a moment ago were easily distinguishable as automobiles. Cigarette stubs glow red in the hands of the people in the car ahead.

Rule 3 calls for putting out the cigarettes. Your auto lights—what remains of them—are thrown down to the road, and would be almost invisible to planes. Your cigarette, moving, could be seen from a plane ap-

proaching from the side. Now for Rule 4.

Put your car in gear. Release the clutch gently in starting. Beginners always want to start too quickly. But remember that you can barely see the road ahead of you. Remember that ahead may lie a rock which you would normally avoid without thinking, but which you may hit squarely if you do not see it in time.

Rule 5 is one of the most important of all: Force yourself to keep your car to the right of the road. There will be a tendency to swing to the left—first just a little bit, then a foot or two, and finally, unless you're extremely cautious, you'll find yourself away over to the left. That's a bad spot to be in if an oncoming car is on its own side of the road. You won't see him until it's too late. And there's no use in hoping that he, too, will be far enough on the left to miss you. If a real blackout comes, you'll have some help in obeying this rule, for the roads will be marked with a white line and the curbs will be whitewashed. But you're on a dirt road tonight—a road closed off by courtesy of the State Police—and there aren't any such guide lines. So you'd better stay to the right or you'll wind up in the ditch.

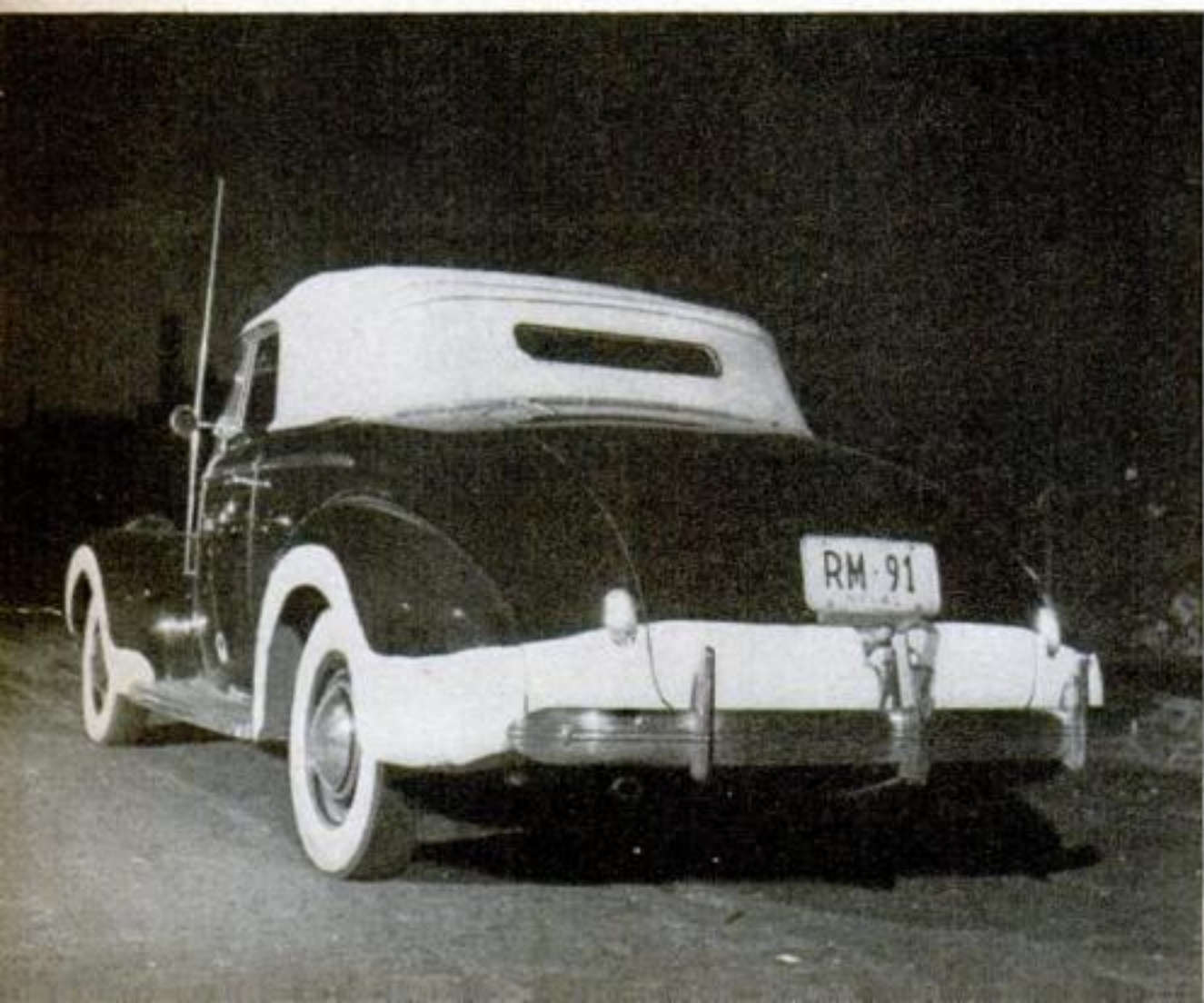
Rule 6 is a common-sense one. NEVER drive more than 20 miles an hour, no matter how clear the road ahead looks. Remember that your visibility is practically nil. Remember that a quick stop may be necessary at any moment. Remember that an obstacle on the road may twist your wheels and send you spinning into the ditch for a personal blackout.

Rule 7 is simple. Be sure you have a flashlight with a cowl over it and with two thicknesses of tissue inside the glass. You may come to a spot so darkened by trees that your auto lights won't penetrate. The flashlight will enable you to leave your car, walk ahead, and survey the road that lies in front. It will come in handy, too, in case you have a flat. Tires have



Rear lights must be cowled so that the dim red glow spreads downward. A strip of white tape about two inches wide, attached to the rear bumper, will help other drivers to spot the car from behind

While tape is satisfactory for practice, white paint is better for real blackout service. It runs around the lower edge of the body





to be changed, blackout or no blackout.

Now you've learned the elementary rules. Some day you may have additional help. The Army Signal Corps is investigating a blackout device designed to extinguish electric lighting systems by remote control through use of short-wave radio. Its inventors say it could be used to black out an entire city from one central point, or to turn off the lights of an armored column from the commanding officer's car, or to provide automatic dimming for automobiles. But that's in the future.

There are rules for pedestrians that have resulted from tragedies in London and other European cities. They may be summed up by the verse that is published repeatedly in all London newspapers:

"When you're walking  
Out tonight,  
Remember this—

Wear something white."

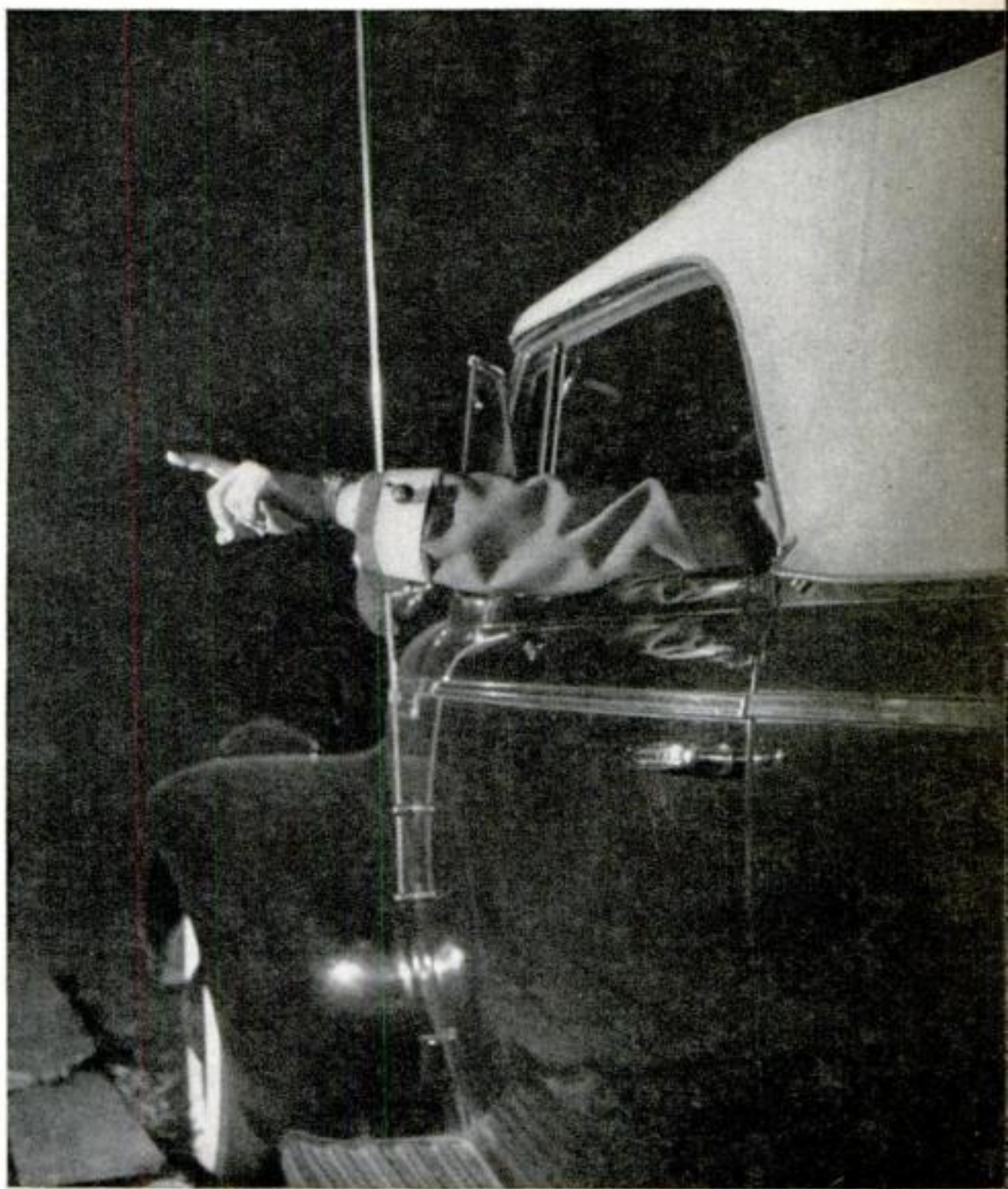
This injunction is needed because pedestrians are almost invisible to autoists—and to other pedestrians—in blackouts. Six London walkers have been killed by bumping into other pedestrians. Twenty-two have been killed by walking into lamp posts and other obstructions.

George Bernard Shaw wears a white coat and carries a white walking stick during blackouts. Women wear white hose and, sometimes, a white panel reaching down the back from the neck to the skirt hem. Some men pin white zigzags of cloth to their trouser cuffs. Almost everyone wears a white sleeve band. A few have luminous buttons on their garments. Police suggest that pedestrians at least carry newspapers.

The absolute necessity of something of the sort will be apparent to anyone who remembers how difficult it is to see a pedestrian at night on a country road, or in the suburbs, even with normal headlights. Ten years ago the problem became so acute in this country that Delaware enacted a law requiring persons walking at night on

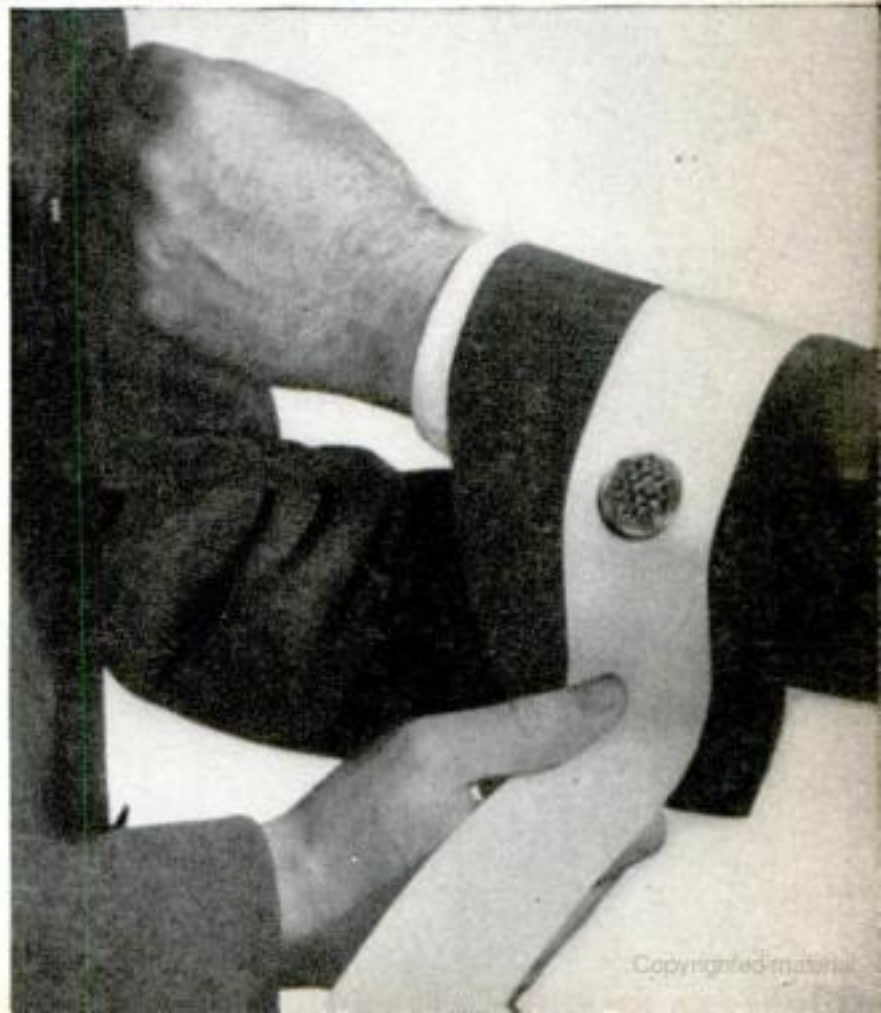
country roads to carry a white handkerchief conspicuously displayed, or a lantern.

In America, it's well to remember the figures as to motorists. In all the world there are only 45,422,411 automobiles. In the United States there are 31,104,118. That's why this nation's drivers ought to get advance knowledge of the ways to prevent an epidemic of the blackout blues.



A white cuff makes it possible for others to see your hand signals. Similarly, pedestrians should wear white or at least carry a paper

Reflector buttons add to the effectiveness of the white cuff in signaling. Some English pedestrians also have the buttons sewn onto their garments







# Auto Workers Have

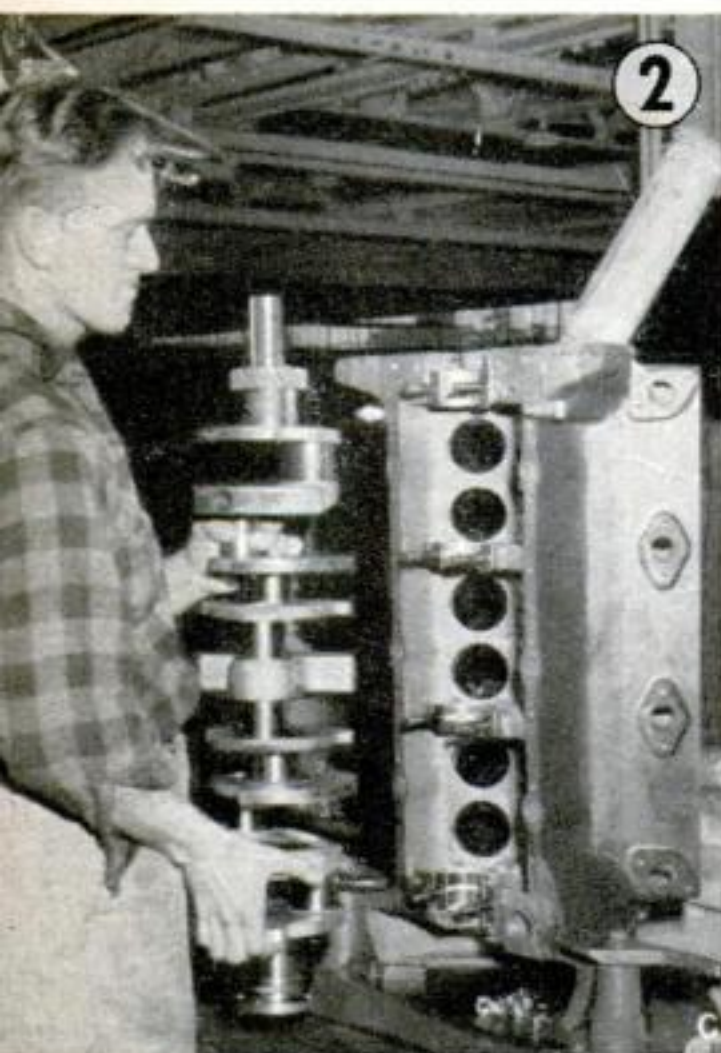
"BUNCH OF BANANAS"

"WRINKLE ROD"

"SNORT PIPE"

"POT" "FISHPOLE" "CHATTER BOX" "CHEATER"

SOME call it slang. But students of linguistic science accord it more respect because they know that many of today's salty phrases become tomorrow's "good usage." In American automobile plants, workers have little truck with scientific terms, and tangy new descriptives catch on quickly. A waggish synonym may spread through a huge plant in a week. Good ones don't stop there, and their final destination may be the dictionary. The accompanying photos, made at the Lincoln Division of the Ford Motor Company, illustrate some of that plant's current words-in-the-making.



**1 BUNCH OF BANANAS.** "Bunch" here is four, the number of "bananas" or bumper guards for one car. A "blue goose" handling them makes special deliveries of assembly materials

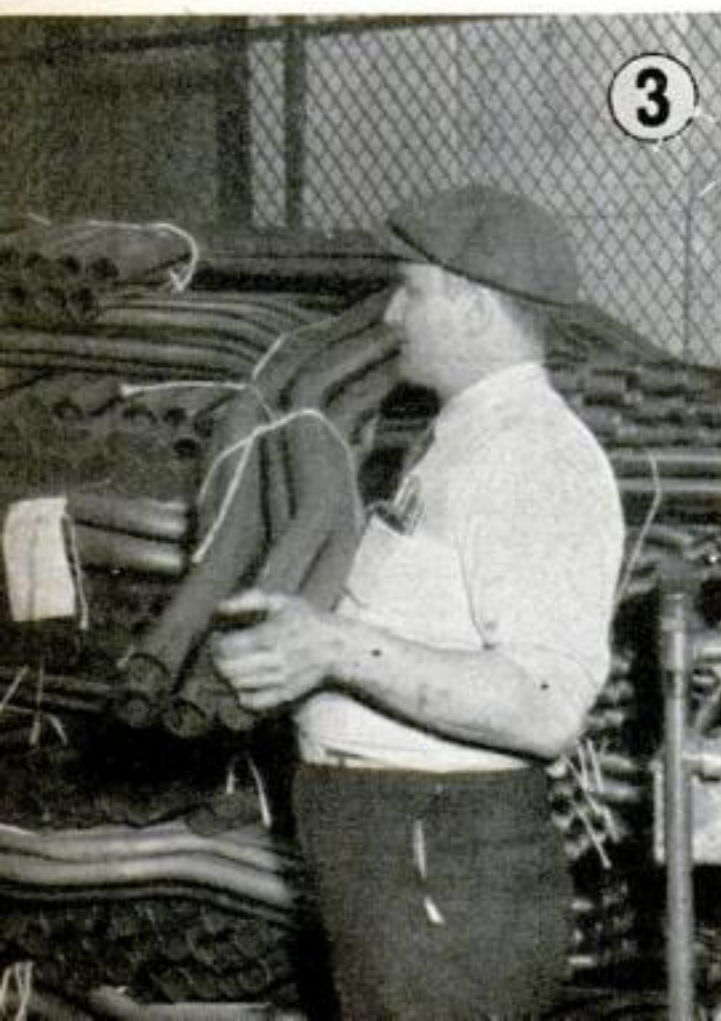
**2 WRINKLE ROD.** Waggish, but descriptive name for a conventional crankshaft. If you've ever seen one turning fast, you'll appreciate better why automobile workers dubbed it with this term

**3 SNORT PIPES** are sections of the exhaust piping. The name vies in overtones with "hoops" for tires and "wind bags" for inner tubes. A car built with right-hand drive for export is a "foreigner"

**4 A POT** is assembly-line for carburetor, which takes too long to say. The big Lincoln-Custom never is called that in the factory. There it is Big Bertha or Queen Mary. Sun visors are "blinders"

**5 FISHPOLE and CHATTERBOX** are part of the argot. "Fishpole" is a common term for the type of radio antenna shown, "chatterbox" is of auto-worker coinage, meaning radio

**6 CHEATER,** or what's-going-on-in-the-back-seat viewer; in short, a rear-view mirror. Another theory is that the name arises from a mirror's ability to reveal a cop before he catches you





# *a Language All Their Own*



## Ford Produces His First 6-Cylinder Automobile Since 1907

A 6-CYLINDER ENGINE, the first built by Ford since 1907, has just been introduced. It is interchangeable with the V-8, which is being continued,

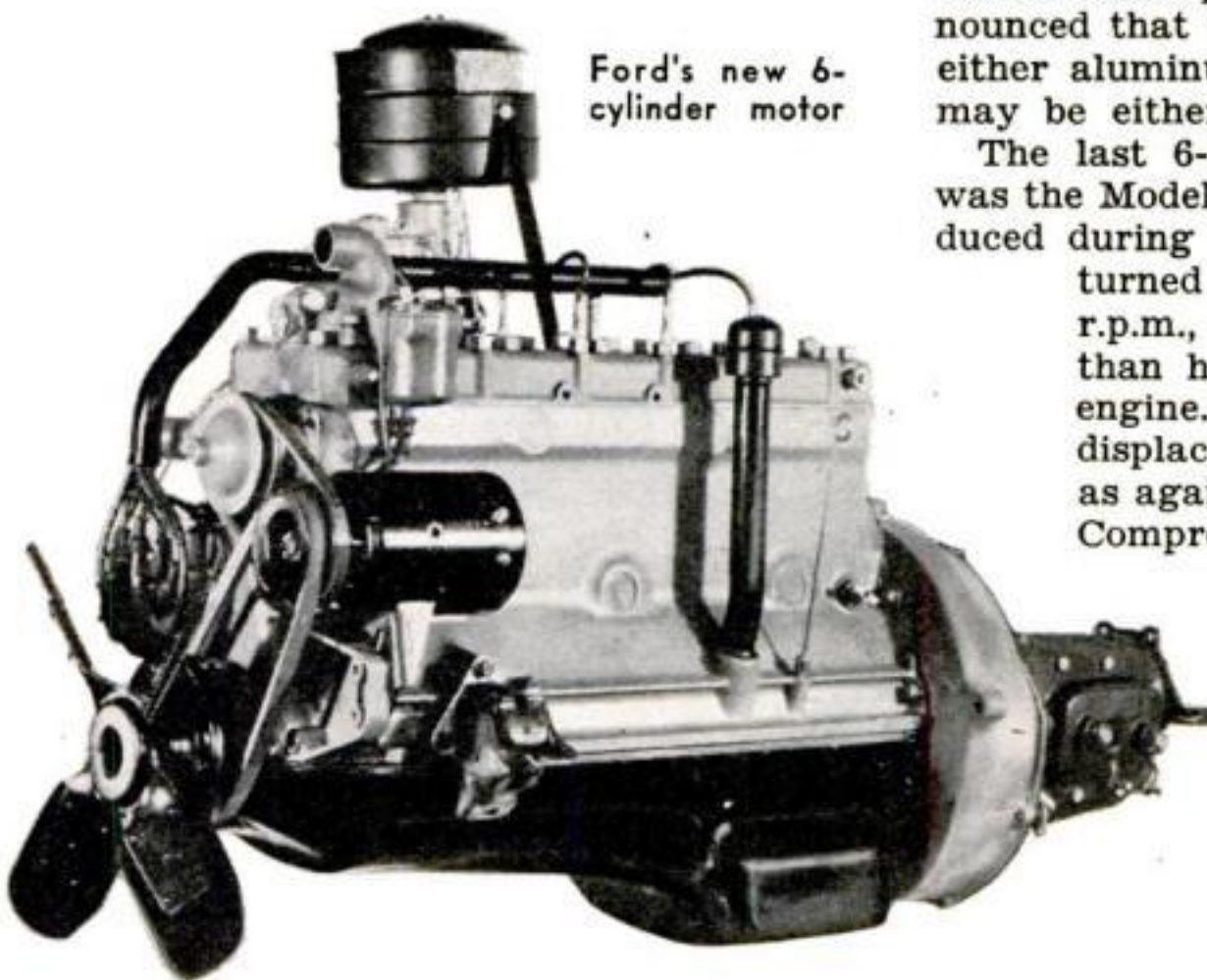
and is optional on all Ford cars. Developing 90 horsepower at 3,300 revolutions a minute, the engine is said to be highly economical. Possible defense priorities demands are provided for, as it was announced that the camshaft gear may be either aluminum or plastic, and pistons may be either aluminum or cast steel.

The last 6-cylinder Ford to be built was the Model K, 584 of which were produced during 1906 and 1907. Its motor turned up 40 horsepower at 1,700 r.p.m., thus yielding a little less than half the power of the new engine. The Model K had a piston displacement of 405 cubic inches as against 226 for the new model. Compression ratio of the old-timer

was 3.5 to 1, which is nearly doubled in the current model with 6.7 to 1. The new motor, shown at the left, weighs 590 pounds.

Ford has produced nearly 30,000,000 4, 8, and 12-cylinder engines.

Ford's new 6-cylinder motor





# What You Should Know About

By SCHUYLER VAN DUYNE

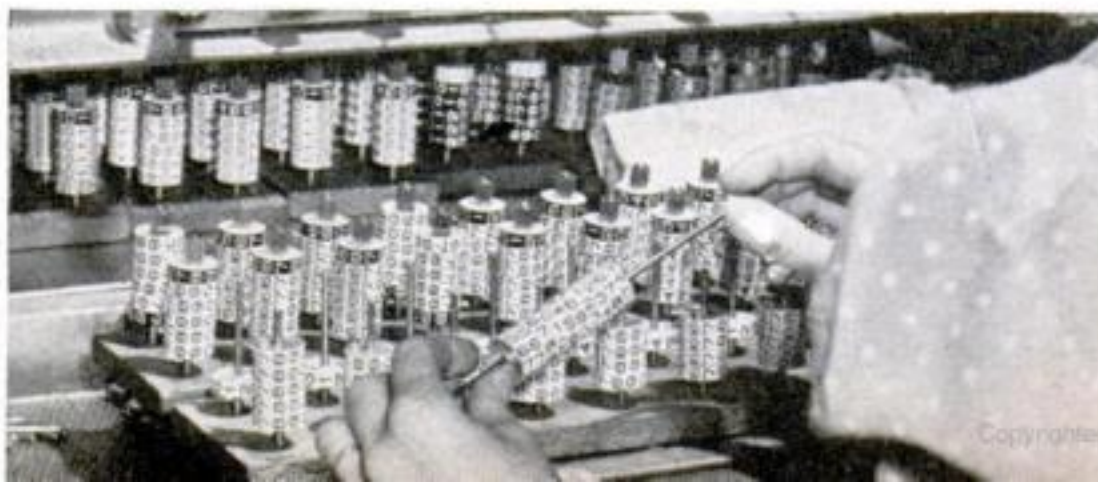
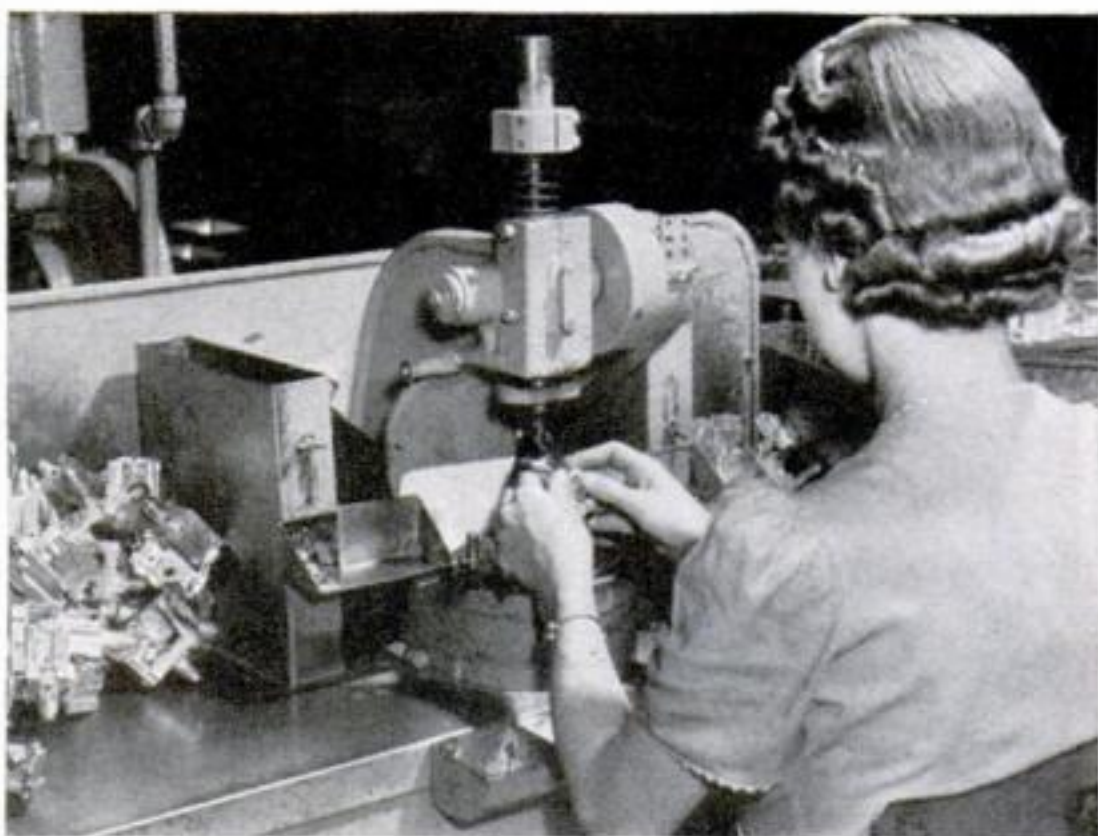
**T**HERE'S one on the dashboard of each of America's 30,000,000 cars. Yet few of the cars' owners know very much about it. They call it a speedometer when it tells them they're getting good gas mileage. They call it cock-eyed when it doesn't. They're wrong on both counts since, technically, it is a velocity indicator plus one, sometimes two, odometers; and it isn't cock-eyed.

There are times when it doesn't tell you exactly how fast you are going, but the fault is not in its watchlike works. The manufacturer set it with a progressive error, which is about two miles fast at 40. Paradoxically, it is a very accurate error—one that will never misguide you into thinking you are going *slower* than you really are!

Most speedometer makers, like the AC Spark Plug Division of General Motors, will gladly explain that this is no trick to make you think you are Barney Oldfield. Tires, they point out, constantly change in diameter, according to your speed, the pavement texture, air temperature, rain, bumps, load, tire wear, altitude, and even pavement color. But wheel diameter governs the reading of your speedometer, so the most accurate instrument

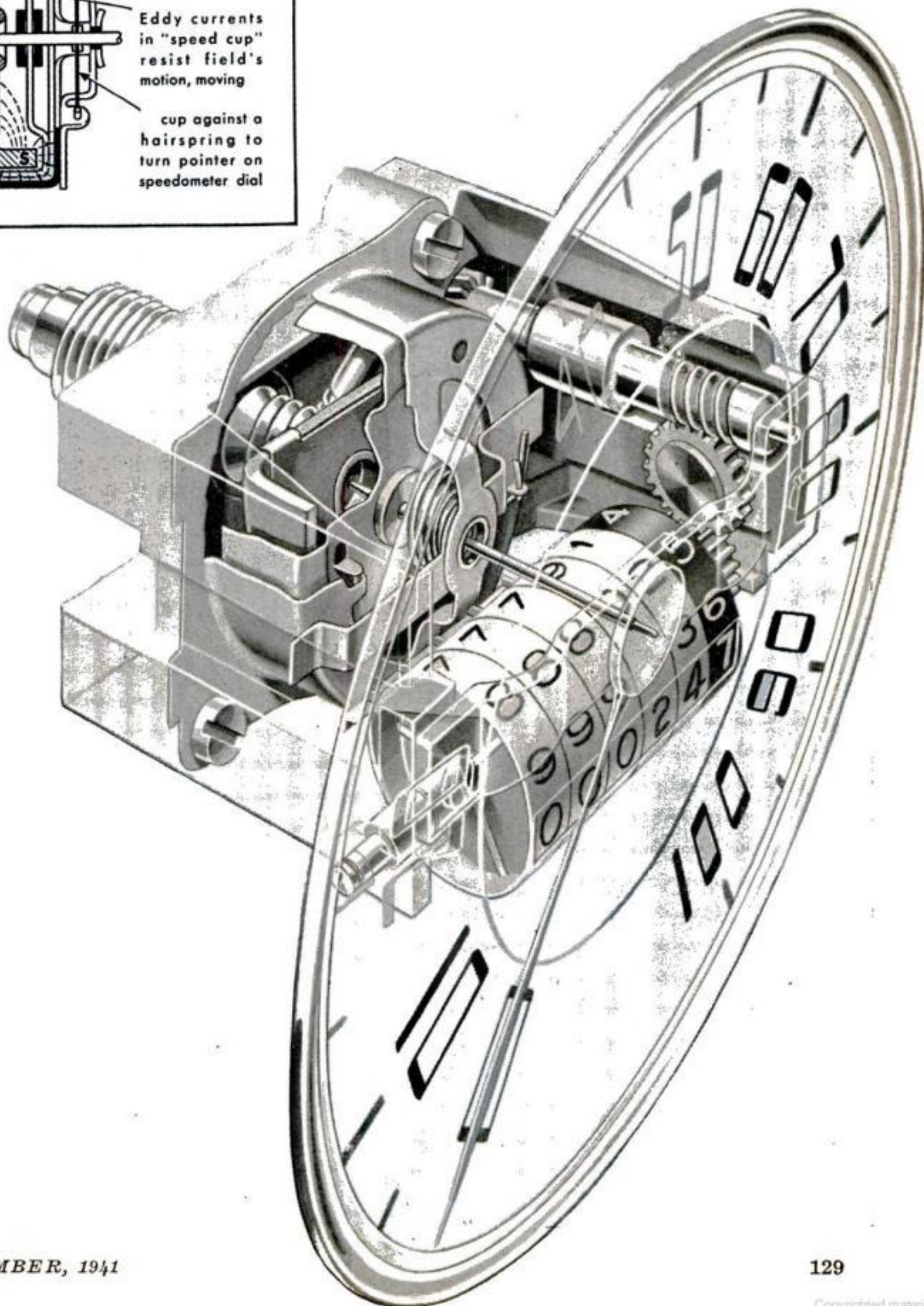
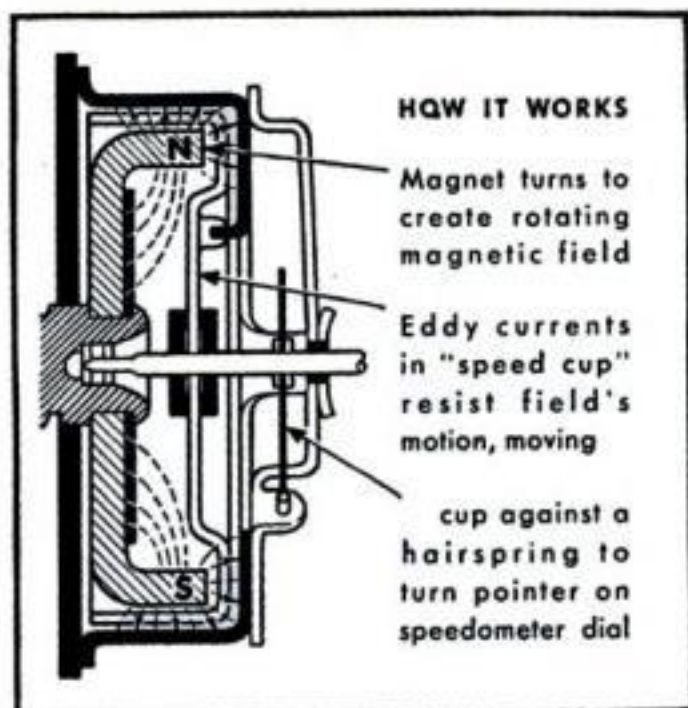
Speedometer calibration at the A C plant, Flint, Mich. Below, melting an ingot of zinc for the speedometer-frame castings

**FIRST ASSEMBLY STEP**, in which a tiny gear is attached to the speedometer frame. Work is so precise that women, who excel men in fine hand work, outnumber men by a dozen to one. Below, putting together odometers demands good eyes and deft fingers. Finished units get "100,000-mile" tests





# Your Speedometer







Fastening speedometers to dash panels with small power screw drivers. The plant builds 7,000 speedometers in a day

bearings like those in a fine clock give it quietness and long life.

AC engineers scoff at the theory that wrecked speedometers, with their "needles stuck at 80," or anywhere else, prove at what speed a car was going before a highway crash. For while speedometers are sturdy, they may not withstand the impacts of violent car collisions. And if something breaks, or a shattered glass lens is shoved into the dial, anything can happen to the needle,

possible still could not tell you exactly how fast you drive at all times. It *might* say you were doing less than the speed limit when you were exceeding it—dangerous business on several counts—if it were not set on the safe, or high, side.

Ask a dozen car owners how their speedometers work and you might get a dozen answers. If one of them says "by magnetism," he's on the right track. For a revolving magnet—driven by the speedometer cable turned by the car's drive shaft—spins within the brim of an aluminum "speed cup." A field plate encircles the cup. While aluminum is nonmagnetic, it does build up curious and little-understood "eddy currents" in the presence of a magnetic field. When the magnet revolves, setting up a rotating magnetic field, the eddy currents resist the rotation in direct proportion to the speed. The cup consequently turns. You have seen a somewhat similar application of the principle in the aluminum disk behind the glass front of your household electric meter. In your speedometer, the speed cup turns against a delicate hairspring, and a hand on the end of the speed-cup shaft points to the proper numbers on the dial for you to read.

In cold weather, there are more eddy currents in the aluminum cup, and readings ordinarily would be high. So a piece of special metal is clamped to the revolving magnet to "short-circuit" some of the magnet's force in exactly the right amount to compensate for the increased eddy currents.

Delicate balance of the speed-cup assembly prevents jolts or changes in car speed from setting the hand into back flips, and

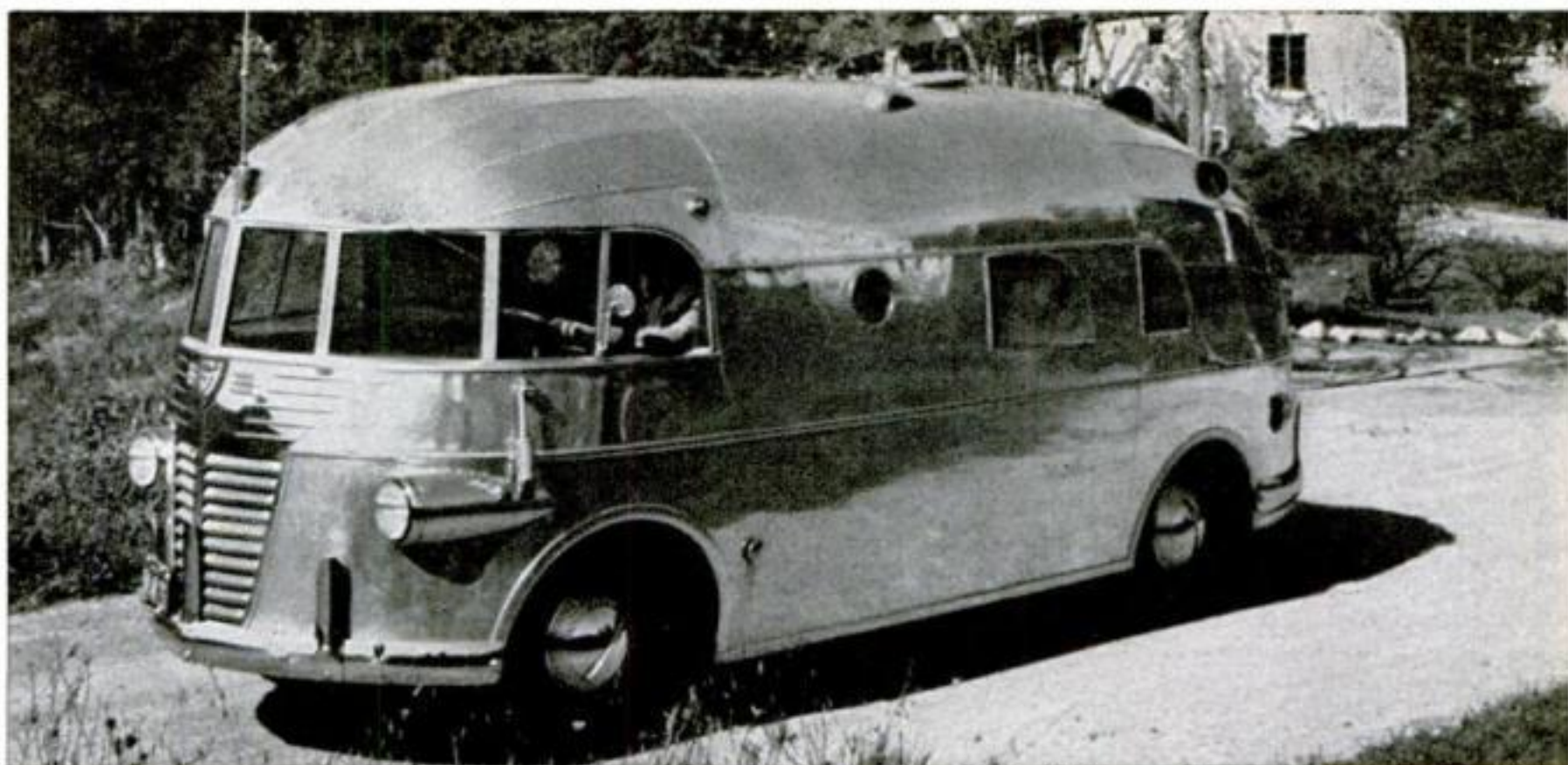
and where it comes to rest is decided by countless different chances of fate.

The worm-gear sets that turn the mileage indicator have a cumulative ratio of 1,001 turns of the speedometer cable to one—or one mile—on the odometer. So, too, the cable turns at 1,001 revolutions a minute when you are driving at 60. These fixed ratios simplify the calibrating of speedometers at the factory, where each is checked with constant-speed electric motors at 10, 30, 60, and 80 miles an hour on its dial.

Once calibrated, it would take a major accident to change them. For by an ingenious method their magnets are made "permanent." To visualize the method, imagine a pail filled to the brim with water. If you tip the pail, some of the water will spill. A magnet, too, will hold just so much and, when "full," a blow or certain types of electrical interference will spill some of its magnetic force. So speedometer magnets are first filled to the brim in a direct-current magnetic field. During calibration, an alternating-current magnetic field that penetrates right through the case of the finished speedometer withdraws much of the magnetism, leaving exactly enough for an accurate reading, but far too little to run any risk of further spilling.

While a stop lug keeps your speedometer hand from recording "below zero" when you back up, there is nothing to prevent the mileage indicator from running backwards. And, of course, mileage indicators can be set back by hand—a somewhat expert hand. Like your watch, however, speedometers are meant to be left alone. Genuine skill is needed to build or service them.





This road cruiser is 17 feet long, weighs 5,045 pounds, and cost its Hollywood owner \$7,000 to build

## Comforts of Home

### IN A STEAM-POWERED HOUSE CAR

A SHOWER BATH, oil heater, instantaneous hot-water system, and an electric refrigerator are but a few of the unexpected luxuries found in a duralumin-covered road cruiser built by J. Roy Hunt, Hollywood motion-picture cameraman, in his spare time. Weighing 2½ tons, this home-on-wheels is driven by a specially designed four-cylinder, 90-horsepower steam engine mounted in the rear of the car.

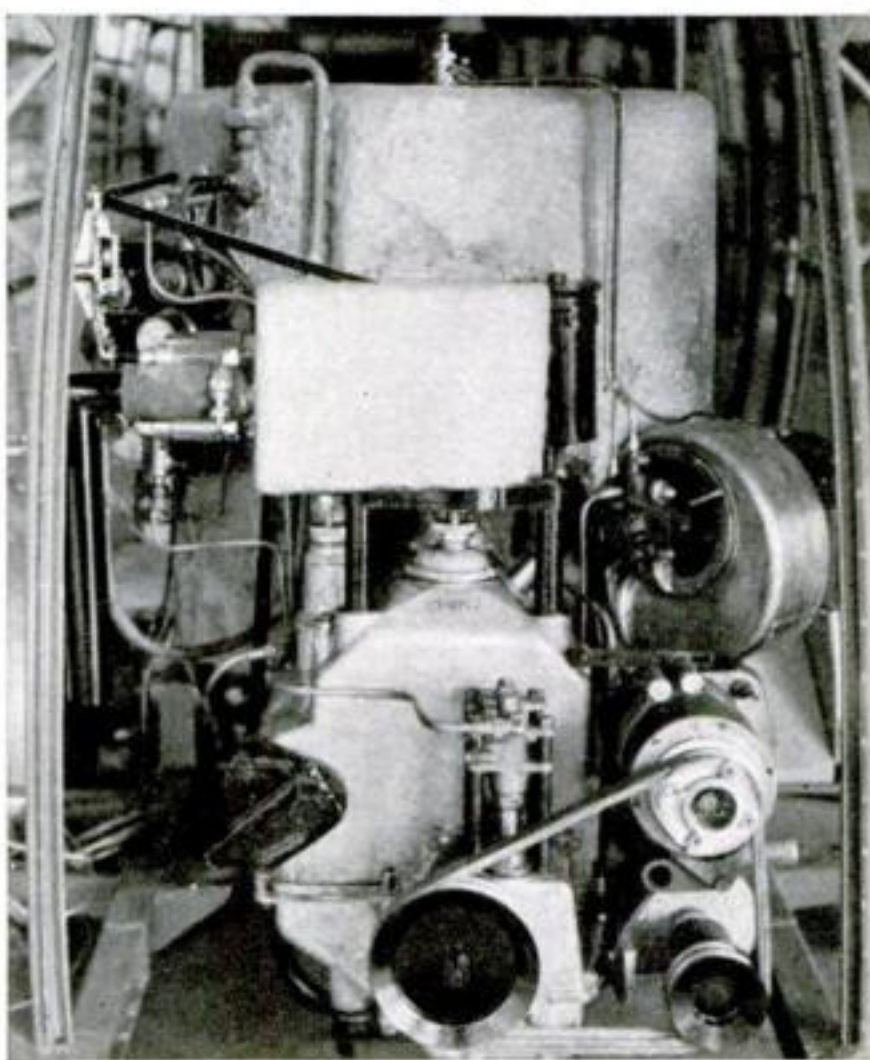


Front and side windows give panoramic visibility



A two-kilowatt, gasoline-driven generator heats water in half a minute and also runs the stove

This four-cylinder, 90-horsepower steam engine pulls the highway pullman on three-cent fuel oil. The engine can be taken out in 20 minutes and a substitute Mercury automobile motor installed





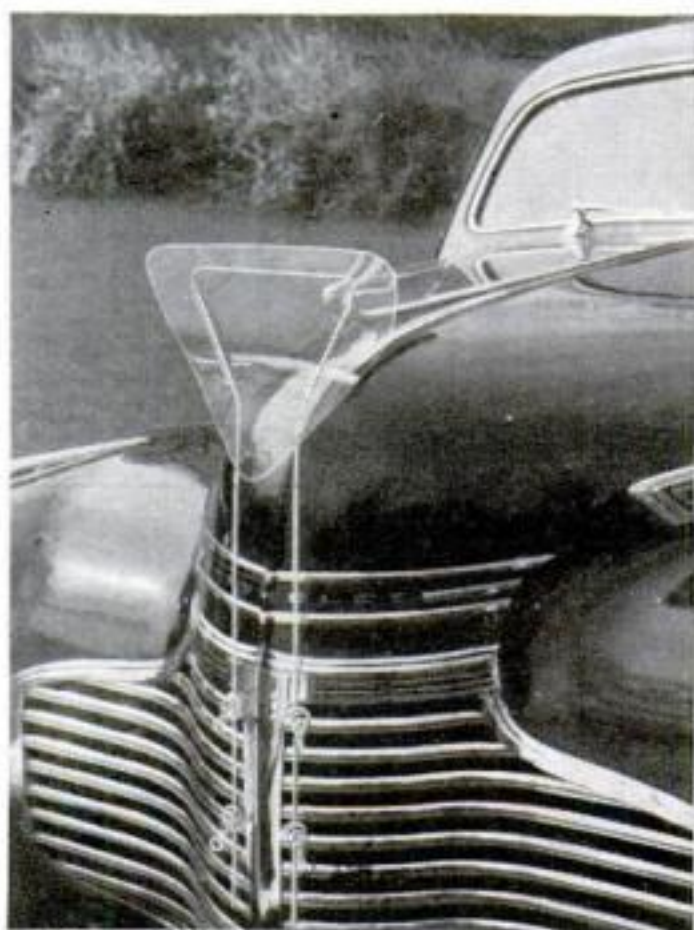
# Auto Ideas

**MUSS, FUSS, AND SPLASHPROOF** car washing is said to be easily accomplished with an attachment that fits on the end of your garden hose. It consists of a spongy pad into which water flows directly from the hose. Fastened to the back of the pad is a rubber glove into which the hand may be inserted. For use, water is turned on and the pad is rubbed over the car surface to clean it. The self-soaking, self-cleaning pad weighs only six ounces.

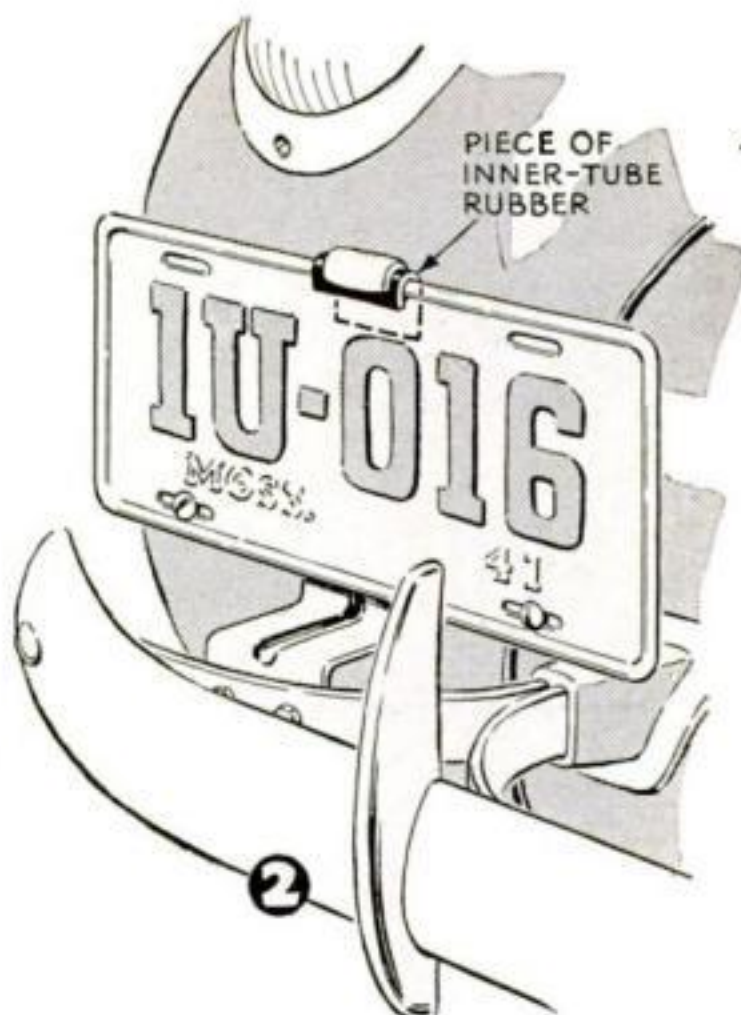


**ALIGNING FRONT WHEELS** while a car is in motion, a novel analyzer recently introduced fastens directly on a car wheel, permitting a comparison of the wheel path of travel with the natural path of travel of the car. In addition, it is claimed that the rolling tester reveals the actual functional relationship of all four wheels, and indicates any out-of-true conditions affecting car handling or tire wear—conditions arising from improperly mounted front or rear axle assemblies, bent frames, incorrectly positioned steering arms, or long or short steering arms, as well as the common alignment errors of caster, camber, toe-in, and king-pin inclination. Garages equipped with the device will not only be able to give better service, but with less trouble.

**A BUG DEFLECTOR FOR CARS**, which can be quickly fastened to the radiator grille, is designed to divert air currents to the top and sides of windshields, carrying insects away from the glass and forestalling accidents caused by bug-blurred vision. It consists of a triangular piece of stiff plastic mounted on a bent metal rod and attached to the grille with spring clamps. Even though bugs may soil the piece of transparent plastic, its small area several feet ahead of the windshield would be no appreciable barrier to vision.







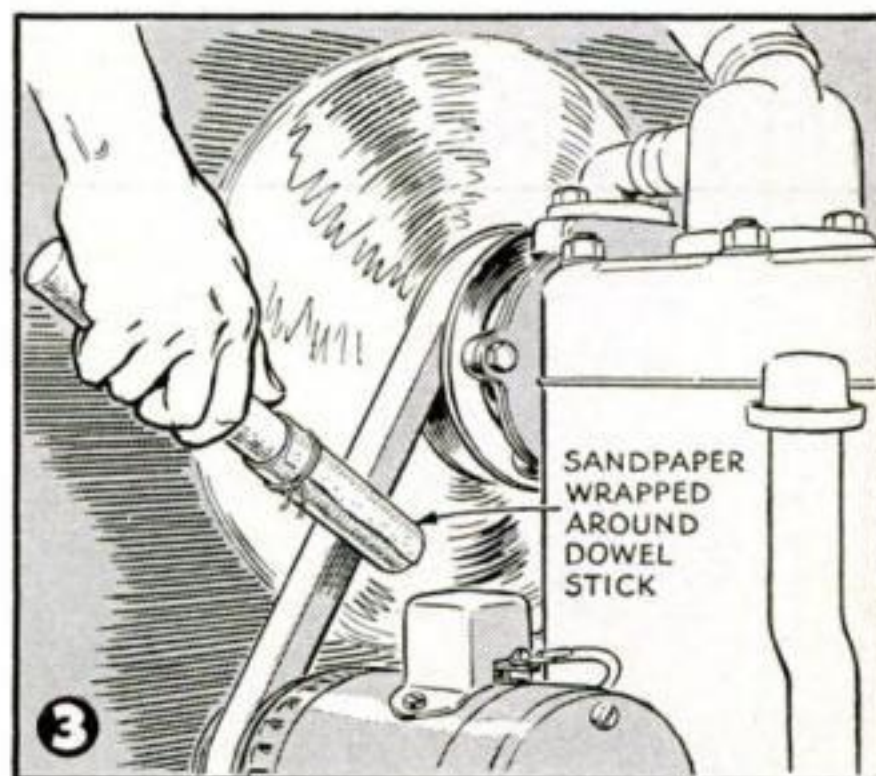
## Four Useful Hints That Help Make Driving Pleasanter

**1 CIGARETTES ARE KEPT HANDY** for motorists in a small pocket of fabric or leatherette attached to the front of the driver's seat. It may be sewed to your slip cover before applying, or stitched directly to the upholstery. The pocket is easily cut out to the desired pattern. If you have no dash lighter, allow room for matches.—A.F.R.

**2 LICENSE-PLATE BRACKET RATTLES** can be stopped with a piece of inner-tube rubber applied at the proper point. A common type of bracket has a sliding member that hooks over the top edge of the plate, and is sometimes difficult to adjust. Rubber inserted between the plate edge and the hook, as shown, does the trick.—W.E.B.

**3 WHEN A FAN BELT SQUEAKS**, try sandpapering it. The easiest and safest way to do this is to wrap a small piece around one end of a dowel stick and tie it in place with string. Keeping the hands and fingers well away from the belt, touch the sandpaper for a few seconds to both sides of the belt with the engine idling.—L.McI.

**4 CAR PASSES FOR BEACHES**, parking lots, and club or factory grounds, are always at hand and easy to display if pasted as shown on your windshield sun visor. This method also eliminates blind spots caused when such items are attached directly on the windshield. Use of adhesive tape permits easy removal of the cards.—J.W.

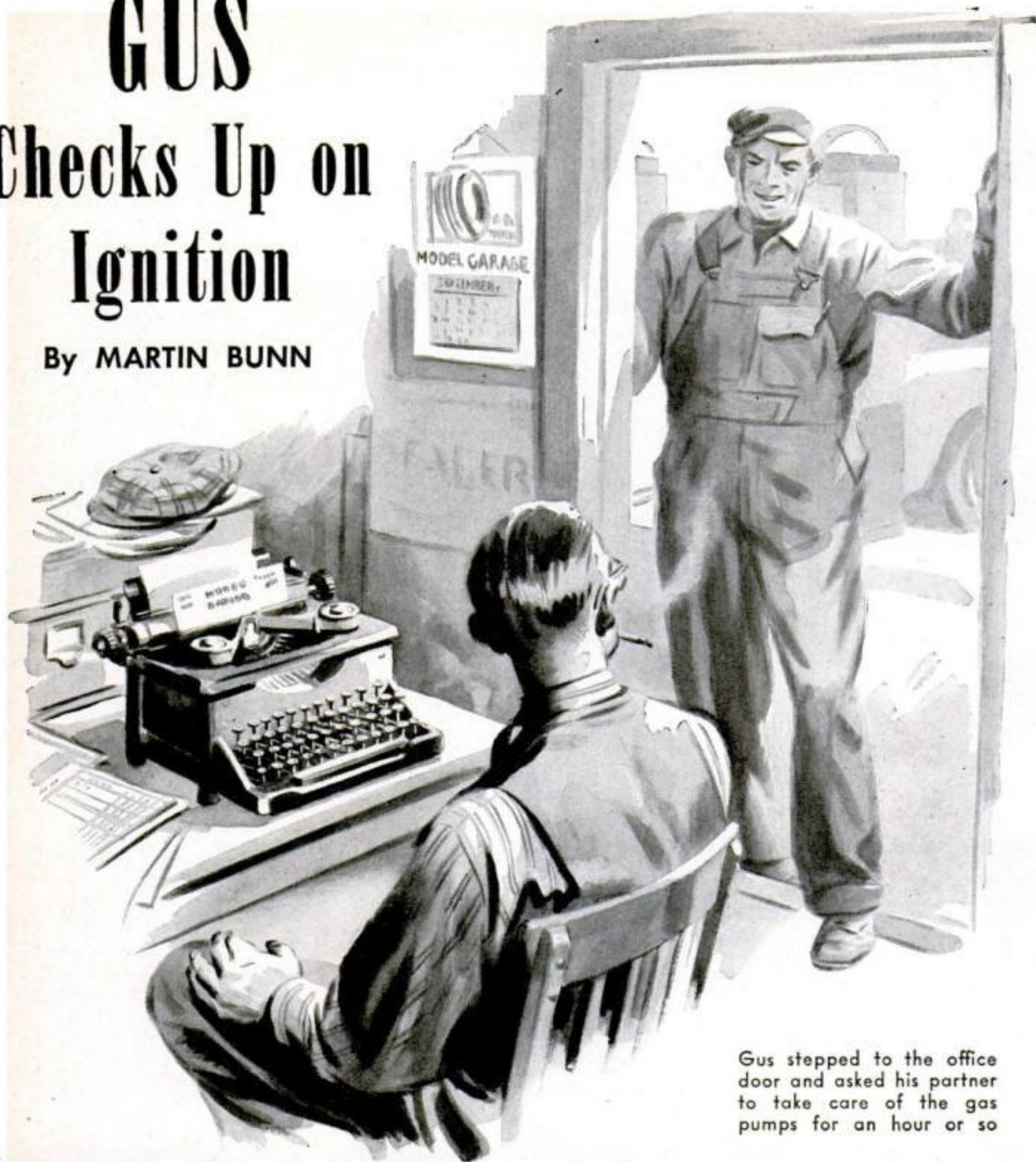




# GUS

## Checks Up on Ignition

By MARTIN BUNN



Gus stepped to the office door and asked his partner to take care of the gas pumps for an hour or so

**B**ACK in his shop from the weekly Kiwanis Club luncheon, Gus Wilson finished shifting into his work clothes, fired up his pipe, and walked over to where a pair of long legs incased in grease-smeared overalls were sticking out at the open front door of a mud-splashed sedan which he recognized as the trusty chariot in which Ez Zacharias carries Uncle Sam's mail over his R. F. D. route in spite of hell and high water. When he got close he heard a steady stream of low-voiced but earnest cussing coming

from under the car's dash, and when he looked in he saw that Johnny Tobin, the Model Garage's new grease monkey, had the floor boards up and that he was examining two badly corroded battery-cable clamps.

"Hi there, Johnny!" Gus said. "What's the matter? Why all the bad language? That job got you down?"

Johnny wriggled his lean and lengthy body backward, got his oversize feet on the shop floor, and straightened up. "It nearly



got me down!" he grumbled. "Those cables were stuck tighter'n—tighter'n I ever saw any before."

Gus stuck his head into the car and took a look at the battery clamps. "They're sure plenty corroded," he agreed. "Before you put the battery on the charger clean those terminals with a solution of bicarbonate of soda and water. Don't let any of it get inside the battery, though. Ask Mr. Clark to let you have some of his bicarb—he keeps a bottle of it in his desk for his indigestion. What's the matter with this battery, anyway?"

"I dunno," Johnny said. "That feller with the postman's cap who owns the car said it was run down, and Bill told me to take it out and put it on the charger and put in a rental."

"Where's Bill?" Gus asked.

"Mr. Clark sent him out on a job," Johnny told him. "But here comes the feller who owns the car, now."

His hands in his pants pockets and his cap on the back of his shaggy head, Ez Zacharias had strolled into the shop. He came over to them, lifted one bushy eyebrow in greeting to Gus, and lobbed a shot of tobacco juice into the waste box. "Ain't you got that rental in my bus yet?" he asked Johnny. "Bill said you'd do it while I went over to the diner an' et. Step on it, will you—I wanta go to the ball game."

"What's the matter with your car, Ez?" Gus asked.

Ez grinned. "She's like me—hot weather's kinda got her, I guess. Hard to get her started, and when she's started she runs sort of jerky and ain't got much pep. I figured the battery must be run down, and Bill sort of agreed with me."

"Oh, I see," Gus said, and took time out to wish that Harry, his old assistant who's a sergeant in the Army now, was back on the job. Bill is a good-enough mechanic but he's not so hot on taking time to find out what's the matter with a car before he starts fixing it, and so far young Johnny hasn't been oversuccessful in applying what he learned from an evening high-school course in automotive mechanics to the realities of a busy shop.

He watched approvingly while Johnny did a good job. "Fine," Gus said. "Now we'll see about the coil."

Ez rang the bell with another magnum charge of tobacco juice. "I wanta see the first innin'," he suggested.

"You take my car to the ball game, and stop by here for yours on the way home," Gus told him. "Maybe the trouble with that old puddle jumper of yours is in the battery, and maybe it isn't. I'm going to give the ignition a good checking to find out."

"O.K. with me," Ez said. "I don't know what's got into her, but the old hack certainly ain't got nearly the pep she ought to have."

After Ez had driven out Gus stepped to the office door and asked his partner Joe Clark to take care of the gas pumps—Johnny's usual job—for an hour or so. "I want to teach the kid something about ignition checking," he explained.

"All right," Joe said. "But you're wasting your time. That boy's a misfit."

"Sure he is," Gus agreed. "So was I a misfit when I started. So were you. Why not give him a chance? Remember how dumb you thought Harry was when he first started to work for us—and where can you find a better auto mechanic now?"

"I wish his time in the Army was up and he was back with us," Joe said.

"Me too!" Gus snapped. "But until he comes back we'll have to do the best we can with what we've got—which is Bill and Johnny."

He went back into the shop, checked Ez's battery and found it in excellent condition, and told Johnny to leave it in the car. "What did they teach you in school about ignition systems?" he asked.

"Oh, all about 'em," Johnny said comprehensively.

"That's swell!" Gus applauded. "Then you'll be able to give me a few pointers as





we check Ez's car. But just for a starter you jump in and switch on the ignition and we'll check the condenser."

Johnny hesitated. "The condenser," he repeated, then added: "Say, Mr. Wilson, I want to tell you that . . ."

"One thing at a time, son—one thing at a time!" Gus interrupted. He separated the distributor contact points with a screw driver. As they opened there was no spark, and the ammeter hand didn't drop back to zero. "There's the trouble! The condenser is occasionally shorted—the way it is right now—so that the current flows right through it. That's what has been causing the hard starting and the jerky running that Ez was complaining about. We'll have to put in a new one. By gum, every driver should carry a spare condenser with him. Then if he has trouble on the road he can install it temporarily without even removing the top of the distributor. All he has to do is scrape off an inch and a half of insulation from the wire running from the coil to the condenser, at a point near the coil, and then wrap the lead of the condenser around the wire and attach the condenser to any part of the motor block where there is a good ground."

Together, they installed a new condenser, then Gus directed Johnny to turn on the ignition. Johnny did as he was told, and Gus started giving the cables and wires the once-over. He pulled the cables leading to the spark plugs out of the manifold and examined them intently. "They look as good as new," he told Johnny, "but it isn't safe to go altogether on looks. When you're checking wiring, *look* for broken insulation, but *feel* for hard insulation. If you find either, replace that cable. Sometimes the heat from the engine bakes the insulation of wires right through the metal plates covering them. As a result, the cable manifold itself may become charged, or voltage may be induced in the wrong cables and cause cross-firing." He went on pulling and wiggling the wires and cables. "How's that ammeter hand—still steady? Then there's nothing wrong with this wiring. All right—switch her off and come down here. I want to show you something."

Gus began to examine the cables running from the coil to the distributor. "Any of these cables with insulation that is even a little worn, frayed, dried out, cracked, or oily should be replaced," he said. "And

be sure to keep your eyes peeled for cables that have gone bad. Here's one—see how the copper core seems to have shrunk back? That's the tip-off that deterioration probably has started throughout the cable. Let's see you put a new one in."

Gus watched approvingly while Johnny did a workmanlike job. "Fine!" he said. "Now we'll check the coil." He pulled the center lead out of the distributor cap. "Switch on the ignition and step on the starter—and watch this lead."

He held the end of the lead close to the engine block. When Johnny stepped on the starter he saw a spark jump the quarter-inch gap. "Switch her off," Gus told him. "That spark shows that the coil is O.K.—if it wasn't, there wouldn't be any spark."

"If a coil is bad, or even a little weak, put in a new one. But on cars which have coils with an armored ignition-cable fastening at the base, make sure that a coil which seems weak is weak before you discard it. Pry the base open, clean the primary connection, and tighten the nut securely. Dirty or loose connections sometimes make a coil of that type seem weak when it is perfectly good."

"One cause of hard starting and poor running is an excessive voltage drop somewhere in the primary circuit—usually the result of high resistance caused by loose or dirty connections, broken or deteriorated wire, or wire which isn't large enough—all primary ignition wire should be No. 10 gauge." He got a voltmeter from the glass-fronted cabinet in which he keeps his instruments and precision tools. "We'll check the part of the circuit between the starting motor and the coil. Close the ignition switch, and make sure that the distributor points are closed and that the ammeter shows a discharge—O.K."

He placed the prod of the voltmeter on the battery-cable terminal at the starting motor, and the other prod on the battery connection at the coil. Then he looked at the voltmeter. It showed a voltage drop of less than a fifth of a volt. "The trouble

isn't in this part of the circuit," he told Johnny. "If there were excessive resistance the voltage drop would be more than a fifth of a volt. But here's something that should be fixed. See the way those strands of wire are wrapped around that terminal screw? Sloppy! Clean the wire, insert it in a lug, and solder it . . . (Continued on page 210)

## GUS SAYS:

Even if you neglect everything else on your car, take care of your tires, brakes, and steering gear. Those three things, along with your driving habits, make you safe or unsafe on the road!



# HOME and WORKSHOP



Save Your Eyesight by Seeing That Your Home Is Well Lighted

NEXT PAGE





**GOOD LIGHTING.** The living room shown on the facing page has been transformed by using 40-watt lamps and clip-on shades on the ceiling fixture and by improving two bridge lamps and adding a third

## ILLUMINATING FOR COMFORT, BEAUTY,

By **WALTER E. BURTON**

**D**URING the next 12 months, more than 1,000,000 babies having normal eyesight will be born in the United States. But of the ones who graduate from high school, one in four will be wearing glasses; among the college graduates, one in three will have defective vision.

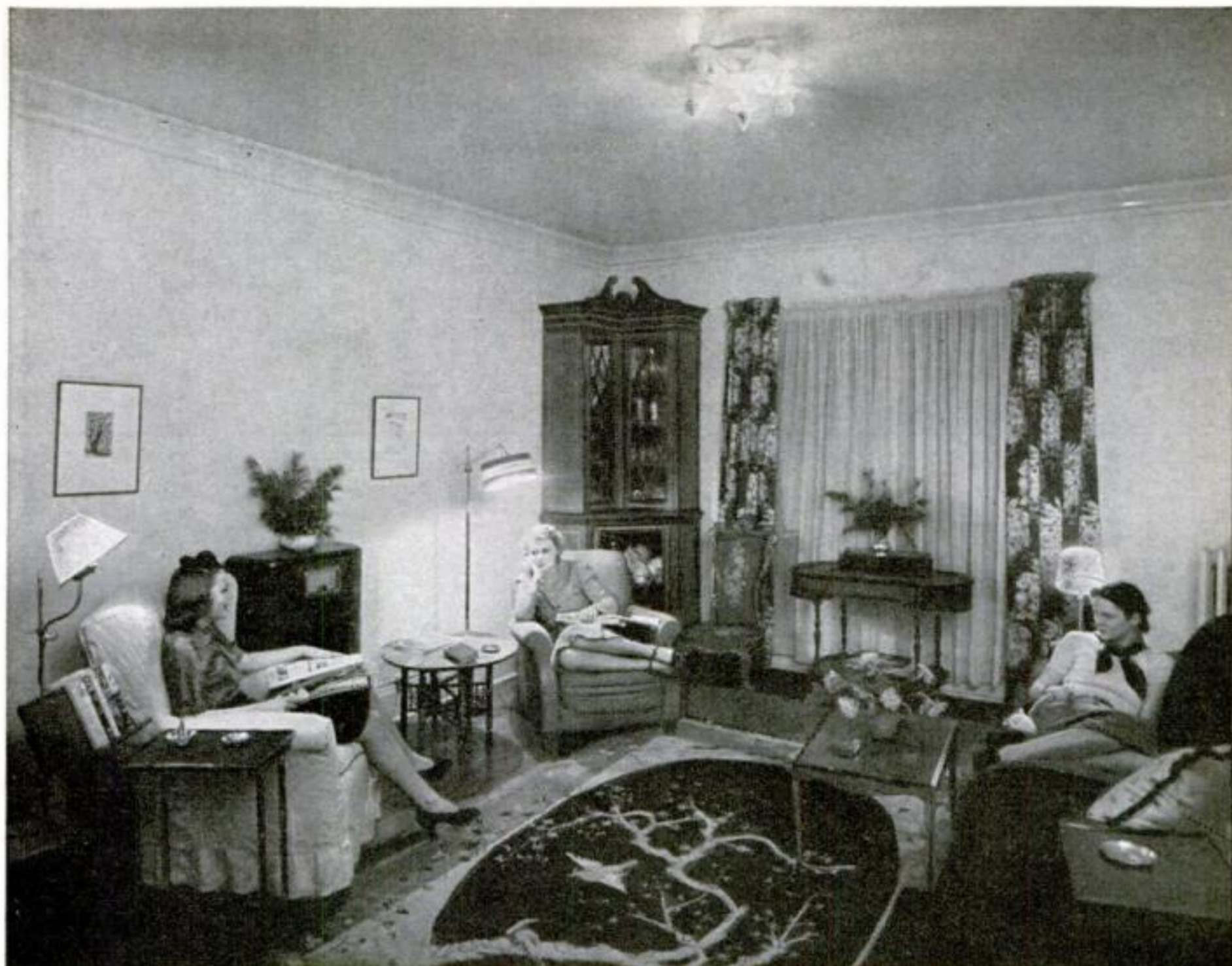
Something is obviously wrong, and it may be that the severe visual tasks imposed by modern civilization are partly to blame. For countless centuries, people probably used their eyes for the most part to look at comparatively distant objects in the daytime. Their seeing equipment became developed for that purpose. Eventually they began to use their eyes hours on end in dim

light for such arm's-length tasks as reading, drawing pictures, and sewing.

In recognition of these deficiencies, modern science is systematically studying the efficiency of various aids to seeing in order to minimize these unfavorable conditions. In particular, Dr. Matthew Luckiesh, director of the General Electric Lighting Research Laboratory at Nela Park, Cleveland, Ohio, has devoted years to such studies. Thus a science of seeing is developing. Perhaps visual troubles never can be eliminated, but it has been proved that they can be lessened greatly by improved lighting.

Researches in seeing reveal definitely the benefits of more light and better lighting in conserving eyesight, in increasing the ability to see quickly and accurately, and in reducing effort expended in close seeing.





**BAD LIGHTING.** Such bulbs as are in the ceiling fixture are bare and of improper size. Floor lamp at left has a tilted shade—never permissible. The center lamp is glaring, the boudoir lamp too small

## YOUR HOME AND EFFICIENCY

In addition to work done in the General Electric Laboratories, careful studies both in the laboratory and in practice have been carried on by many universities and by the Illuminating Engineering Society, an international organization founded for the development of good illuminating and engineering practice. The basic work of these groups has established new standards of design and lighting technique that should guide all users of artificial light. But much of the value of this scientific and engineering background can be lost by the consumer of light who fails to observe the main principles of good lighting.

Before listing some of these principles, here are a few things that good lighting, as compared with bad, has accomplished. These are case histories as given by Nela Park

research specialists and lighting engineers:

"A three-year test on the rate of operating certain business machines showed an increase of nearly 50 percent when the intensity of illumination was increased from 10 to 75 foot candles.

"Students in well-lighted classrooms have advanced 10 percent faster in 'educational age' than those in poorly lighted rooms.

"It was found possible to measure the tenseness unconsciously developed during half-hour reading periods under levels of illumination varying from 1 to 100 foot candles. Nervous tension, as measured by the unconscious contraction of the muscles of the hand, decreased steadily as illumination was increased.

"Numerous studies have shown that the rate of involuntary blinking is an indication





of the amount of ease and comfort in seeing. The rate of blinking increases when conditions for seeing are made more unfavorable. When a low-wattage bare lamp was placed just above the line of vision of persons reading during a series of tests, the normal rate of blinking was increased more than 50 percent, indicating the harmful effect of glaring light. The rate of blinking was also studied while reading a book in surroundings which were both darker and lighter than the book. This test revealed that the rate of blinking was slowest when the book was the same brightness as the general surroundings."

Such tests and studies have been translated by lighting specialists into practical recommendations for lighting the home, office, factory, or wherever human eyes are used in artificial light. The following recommendations apply to the home:

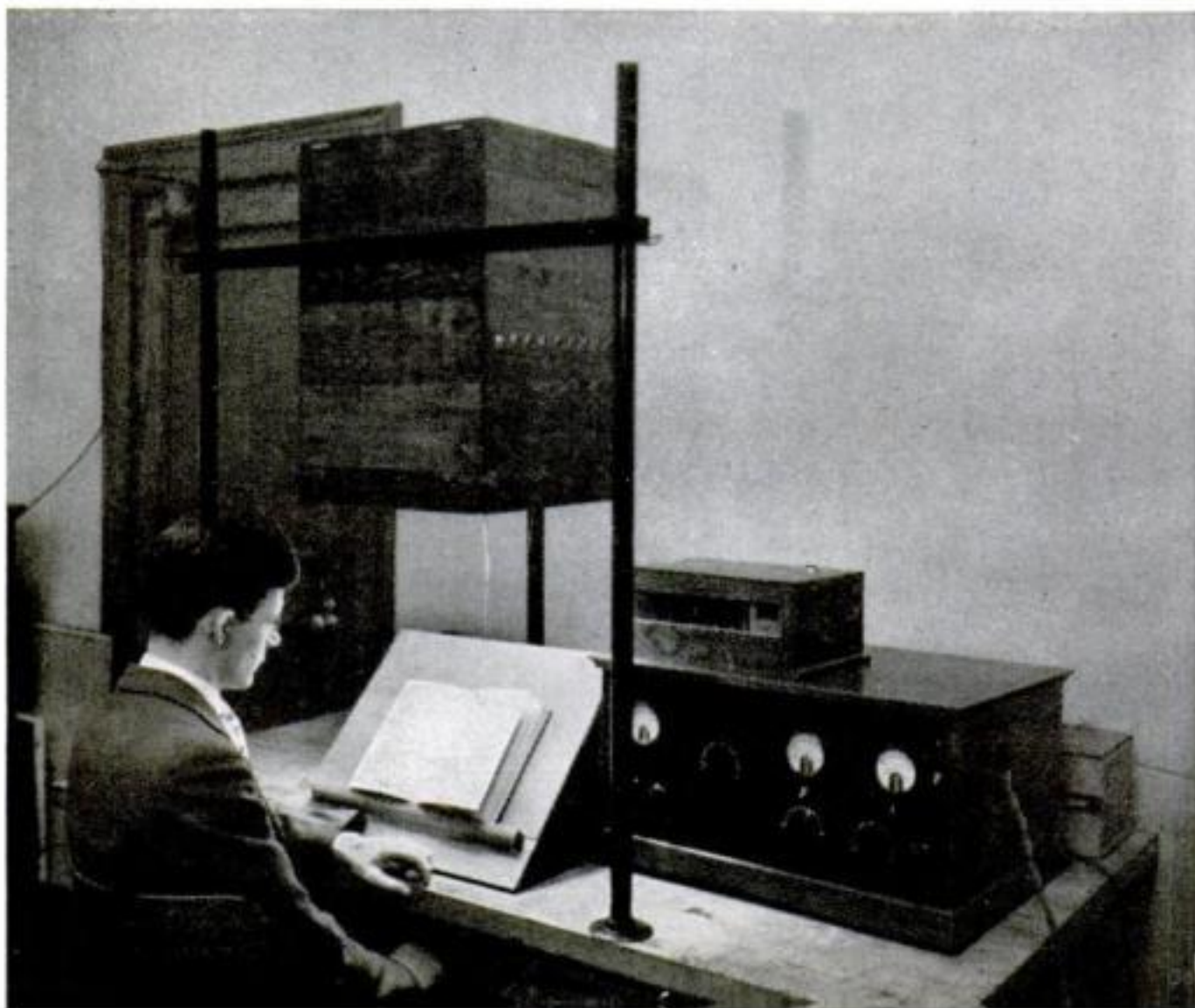
Every major room should have a ceiling fixture. Wall brackets also are required for work surfaces and mirrors in kitchen and bathroom, and may also be used where desired in recreation rooms, dining rooms, and living rooms. Use no fixture that reveals a bare lamp bulb. Glass or plastic diffusion bowls, reflecting surfaces, and in some instances silvered-bowl bulbs help produce lighting that is easy on the eyes.

Work places like kitchen, laundry, bathroom, and sewing room require fixtures having high light output and diffusing bowls or reflectors that distribute light over a wide area. Fixtures in living, dining, and recreation rooms can be more ornamental, but always should produce some useful light. Light from a fixture should spread over most of the ceiling area, and from 65 to 75 percent should be reflected from the ceiling. Kitchens, laundries, sewing rooms, and workshops require walls reflecting 65 percent or more light; other rooms, no less than 35 percent.

Portable floor, wall, and table lamps aim at localized targets, leaving the main fixtures to lay down a general light barrage. Most efficient are those certified to meet Illuminating Engineering specifications, which require them to pass tests of 54 points before they

Nine progressive stages in the cycle of one blink. The so-called "rate of blinking" is a reliable measure of the amount of ease or fatigue in seeing

Present-day lighting methods are based on extensive research in the science of seeing. Many tests, even as simple a one as measuring the frequency of blinking under various conditions, require elaborate apparatus. The set-up below is used to study the effect of infra-red light on eye-muscle fatigue
















can wear an I. E. S. tag. Obvious characteristics of an I.E.S. lamp include a diffusing bowl around the bulb, an open-top, white-lined shade, and sometimes, in addition, candles shielded by diffusing cups.

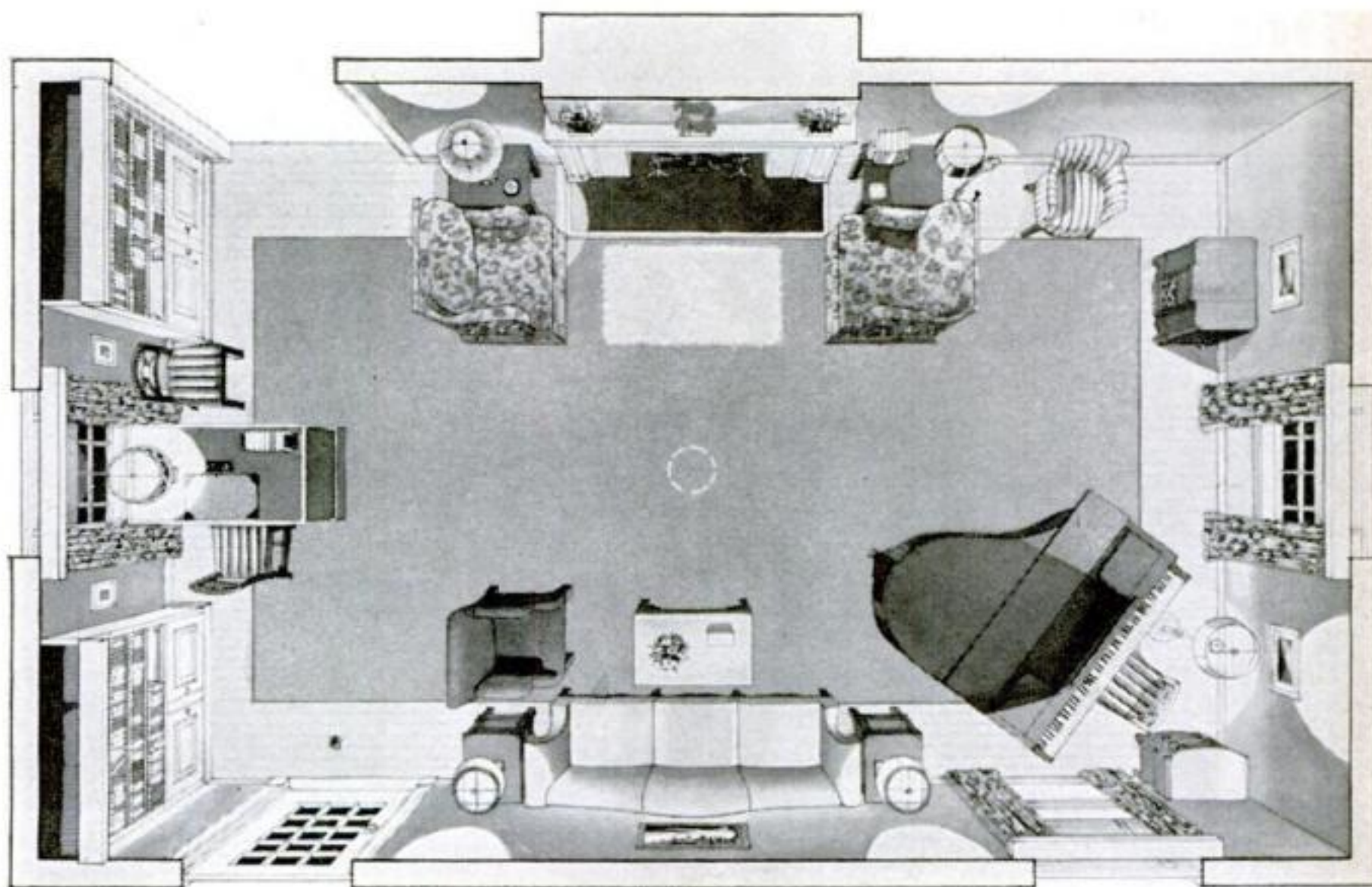
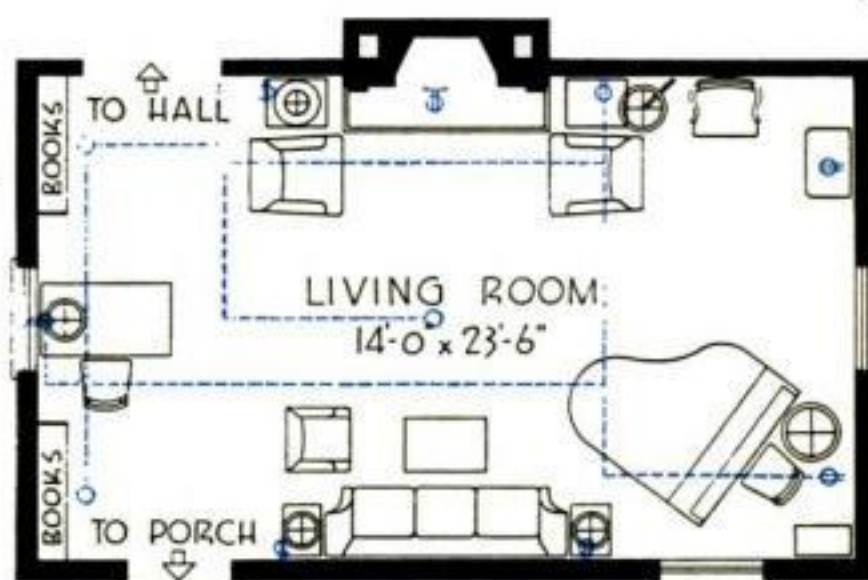
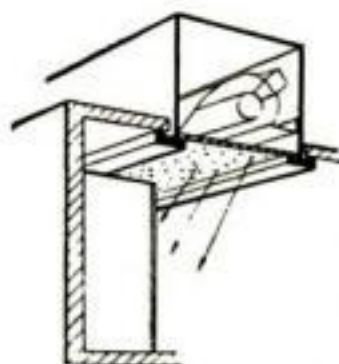
Place a portable lamp at the side of a desk, one at each end of the davenport, one beside and slightly to the rear of every easy chair or other reading center, one beside the piano, one or two above the head of each bed. Keep diffusing bowls and bulbs out of the line of vision. If you are right-handed, have the lamp on your left side for writing and other handwork. Height of table lamps generally ranges from 19" to 28", of floor types, from 58" to 63". Wattage is 100 to 300 in diffusing-bowl portables, and 40 to 60 for each candle.

For any kind of local task such as reading, use room fixtures and portable lamps *together*. Portables alone cause too much contrast, which is distracting. Use the max-

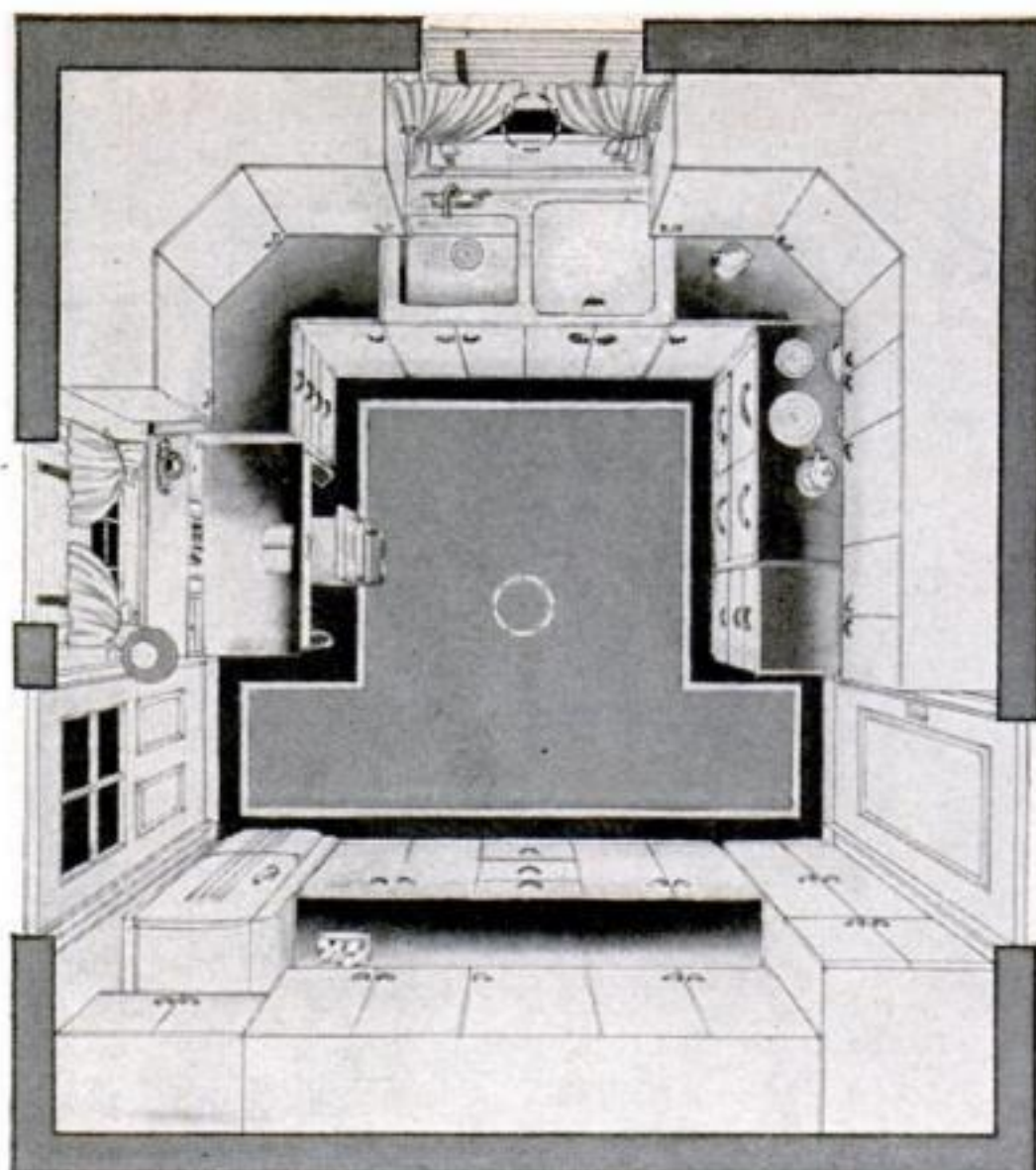
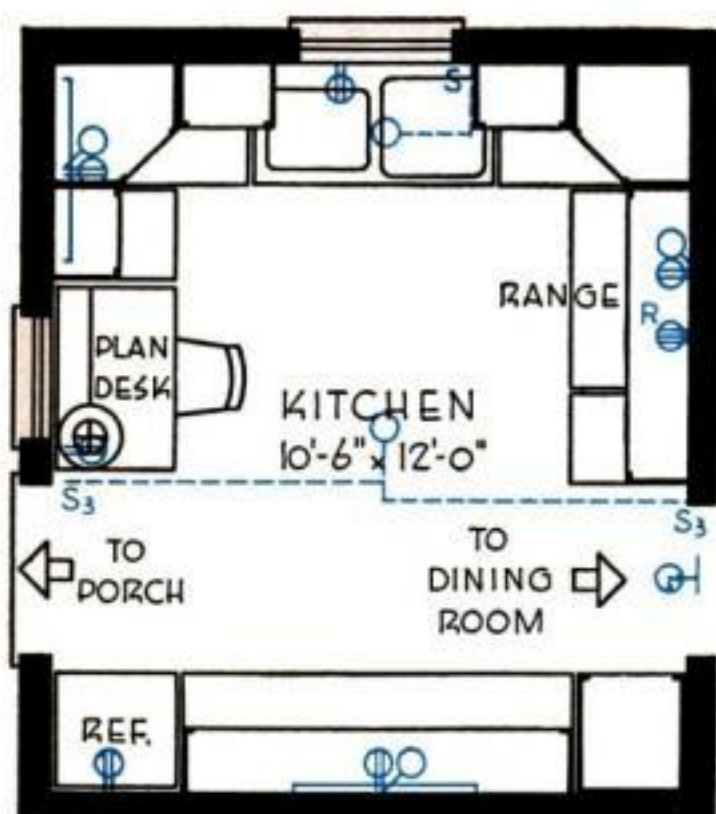
## WIRING SYMBOLS

-  Ceiling outlet
-  Wall outlet
-  Lamp holder (pull switch)
-  Convenience outlet
-  Ceiling convenience outlet
-  Clock switch
-  Single-pole switch
-  Three-way switch
-  Switch and convenience outlet
-  Range outlet
-  Combination work light and convenience outlet

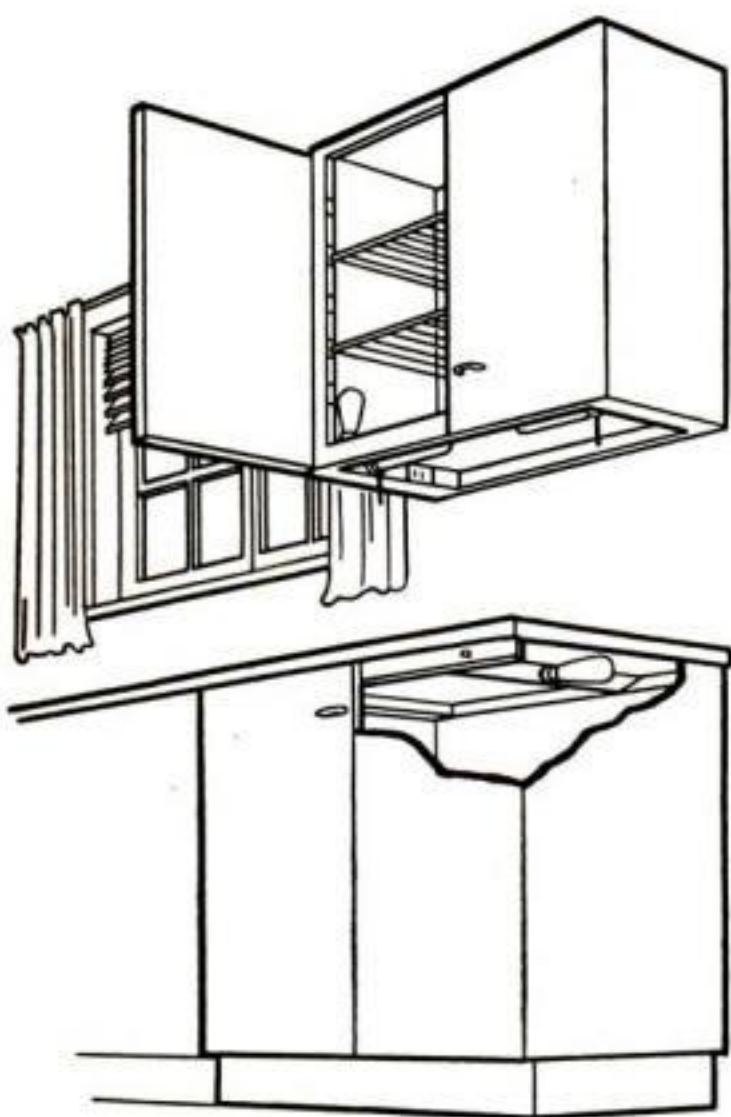
Below is a view looking down into a well-appointed living room as if the ceiling had been removed. A plan view of the room appears at the right, and the electrical fittings are indicated by the wiring symbols shown in the key above the plan. The small sketch at right illustrates how 30-watt lumiline lamps in parabolic reflectors are used above the twin bookcases to direct light down through sheets of stippled or etched glass







Nowhere is good illumination more important than in the kitchen. The ceiling light is a 100-watt lamp within a globe. A pin-to-wall lamp is hung on the window casement above the housewife's planning desk. At left is a sketch to illustrate how lamps may be used above the working top of a kitchen cabinet. Small lamps are placed in the cabinets



imum light output of the portables, which must be placed close within each furniture grouping. Room fixtures should furnish one foot candle for every ten from the portables. Of course, if you merely are listening to the radio or talking, a lower all-around amount of light is enough.

Lighting a home can be divided into a number of parts according to activities:

**Circulation.** Keep lines of movement well lighted. Brackets with diffusing bowls or built-in light boxes flanking the outside of an entrance door will enable you to see whether a caller is friend or foe. The house number should be lighted at all times of darkness; a 7½-watt lamp will do it and scarcely move the meter. For the garage it

is desirable to use a 40- to 100-watt lamp in a diffusing globe over the door; 100-watt lamps in angle brackets in each inside entrance corner, and a 150-watt lamp in a 12" globe or reflector over each car hood. Illuminate hazardous steps and dark walks with pilot boxes inset in nearby concrete or mounted on posts. Prowlers are discouraged by floodlight units mounted under house eaves and controlled by three-way switches in the master bedroom and downstairs. Hallways require shallow-bowl units mounted close to ceilings. These can perhaps be placed to light shallow hall closets as well. At the foot of basement steps, have a ceiling fixture controlled by three-way switches in basement and at head of stairs.

**Dining.** Here foot candles are less important than charm and atmosphere. The main lighting element is a ceiling fixture aimed downward toward the table. When the table is lighted by wax candles, background illumination can be had from lighted urns on the buffet, lighted valances and coves, a pair of *torchères*, wall brackets, or lighted corner cupboards. For such dining-table activities as working on a stamp col-



## YOUR EYES NEED MORE LIGHT

Illumination is measured in foot candles. One foot candle is the amount of light illuminating a perpendicular surface one foot from the flame of a standard candle.

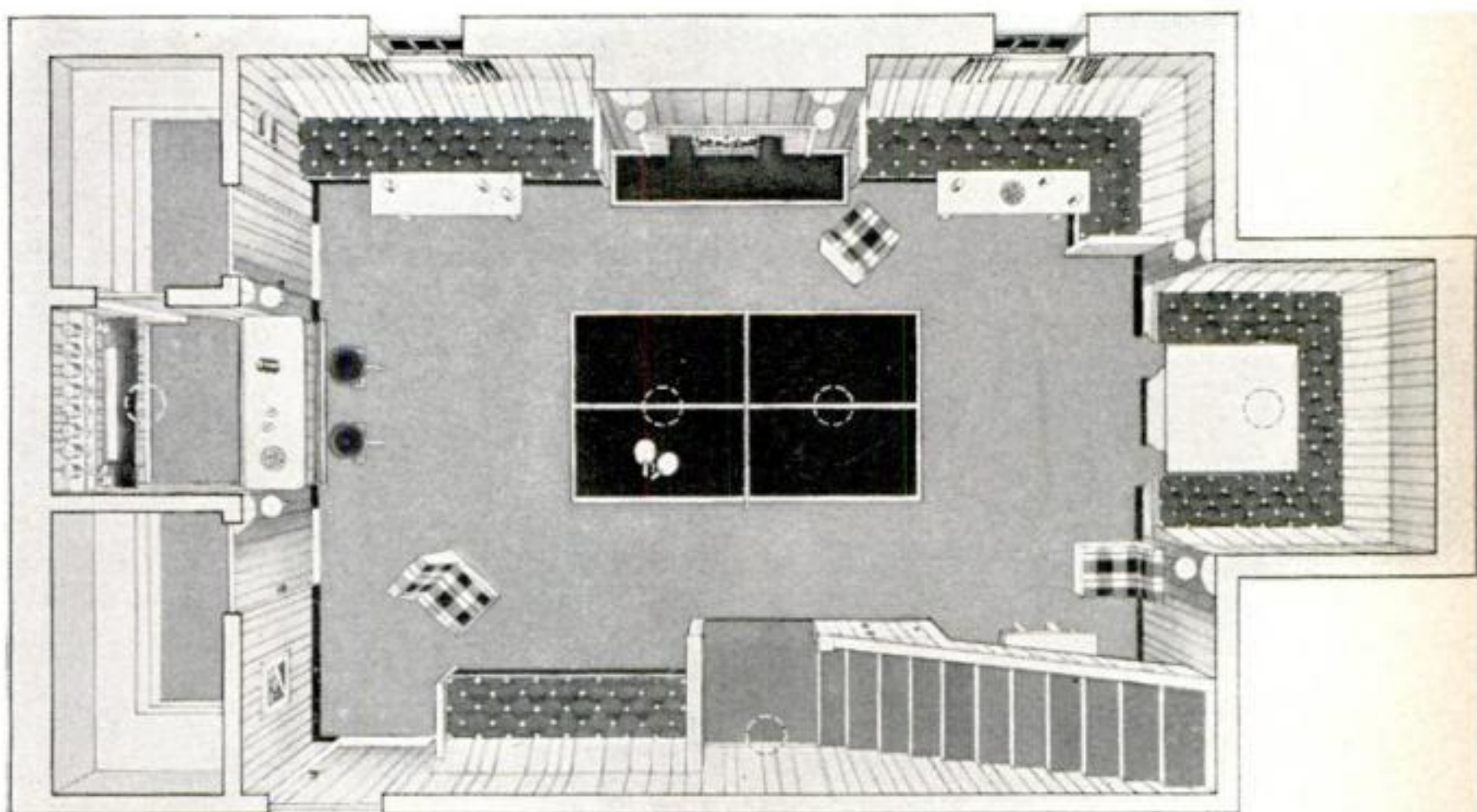
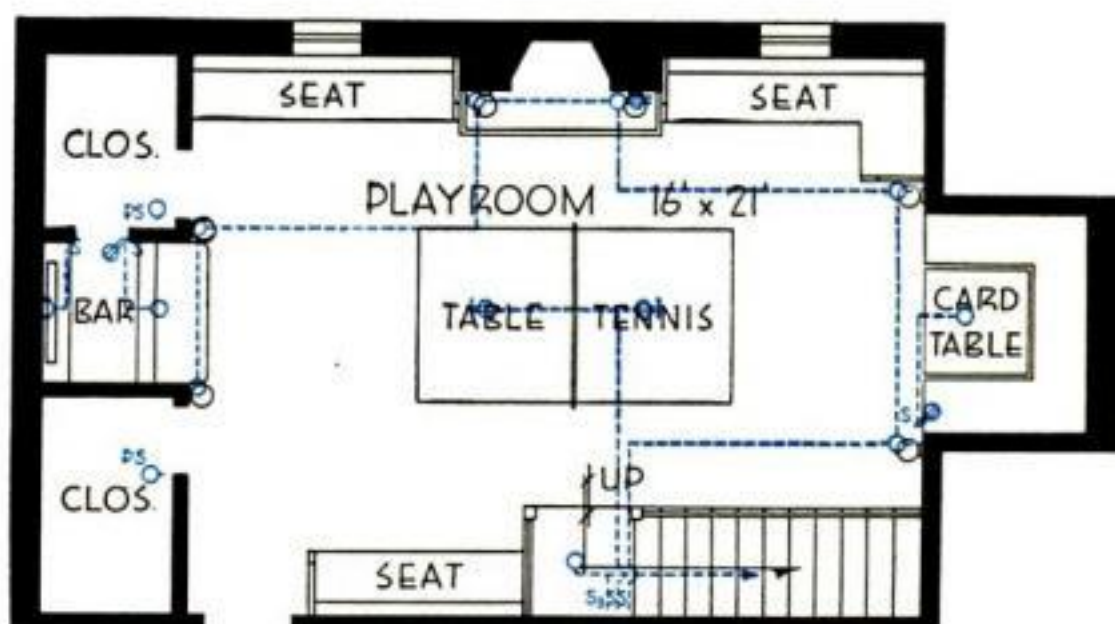
For rooms where there are reading lamps or other local sources of illumination of from 20 to 100 foot candles, it is sufficient to have a general illumination of from 5 to 10 foot candles. This applies to the majority of rooms, including the home workshop, children's playroom, and laundry. On stairways and landings the general illumination can be reduced to from 2 to 5 foot candles.

The main problem is to know how much local illumination is required for various occupations. For example, the ideal level for reading black print on white paper is over 100 foot candles.

Lighting specialists make the following recommendations for the minimum foot candles to be used for various occupations:

Occupation	Local light in foot candles
Card playing, dining	10 up
Sewing on white cloth, coarse knitting, washing, ironing, playing (children), reading good print	10 to 20
Reading newspapers, clerical work, children's homework, sewing and mending on light-colored material, shaving and make-up, drawing, carpentry, general shop work	20 to 50
Fine sewing or sewing on dark material, prolonged reading, fine pen work and engraving, assembling small machine parts, inspection	100 and up

Ideal illumination for a recreation room is illustrated in the large drawing below. The small detail shows how a 30-watt fluorescent or lumiline lamp in a sheet-metal trough is used at the rear of the bar, covered by stippled glass. The shelves above it are ordinary glass





lection, a semi-indirect, pendant-type fixture giving high downward intensity is excellent.

**Housekeeping.** In the kitchen, use either a central fixture with a 100- or 150-watt inside-frosted lamp, a 200-watt silver-bowl lamp, or from two to four 20-watt fluorescent lamps. Provide local lighting at sink, range, and work surfaces. Shield all lamps from eyes. If work surfaces are shiny, use indirect lighting over them, with walls and cabinet bottoms as reflectors. Some kitchen cabinets have lighting units and convenience outlets built into their bottoms. Extremely handy are inside-cabinet lamps that light when the door opens.

Over each laundry tray and ironing board, place a 150-watt daylight bulb in diffusing bowl, or daylight fluorescent tubes.

A 60-watt pull-cord bracket over the door frame will illuminate a small clothes closet. A ceiling fixture with wall switch or automatic door switch is better for large closets.

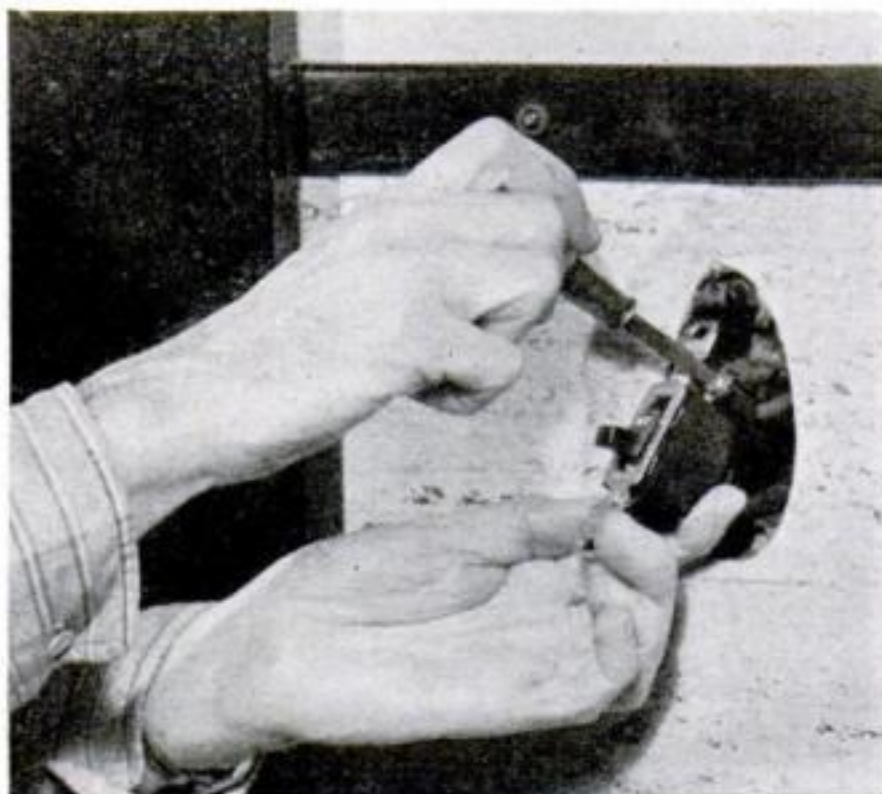
Silvered-bowl lamps, burned base up, can be used in closet ceiling sockets without diffusing equipment.

**Bathrooms.** Use a ceiling fixture having a 75- or 100-watt lamp. Cutting or not cutting your chin, when shaving, depends a lot on mirror lighting. Either use 60-watt lamps in diffusing wall brackets 66" from floor and spaced 30" apart, or flank the mirror with a pair of 15- or 20-watt fluorescent lamps or shaded 40- or 60-watt lumiline lamps mounted vertically. Similar lighting, at a lower position, will serve a dressing-table mirror. A useful trick is to mount one pair of daylight fluorescent and one pair of white fluorescent lamps flanking the mirror. Use the daylight pair for daytime makeup, the white pair for night-time powdering. To light a shower stall, use a waterproof fixture wired to a switch *outside* the stall.

**Handwork.** Sewing, drawing, and other detailed tasks require high light intensities.



One way to light a table-tennis table. The lamps plug into a ceiling convenience outlet so they can be moved when the room is used for dancing



If you want wall switches to be perfectly noiseless, you can replace old-style switches with silent mercury switches, one of which is shown above

Don't read in bed like this! The table lamp is entirely too small and the shade is tilted, thus exposing the bulb and causing unnecessary glare



A pin-to-wall lamp with diffusing bulb provides sufficient illumination. It is even better to use two such lamps, one near each corner of the bed





Portables using not less than 300 watts placed close at the left side of the work usually prove most satisfactory. Daylight incandescent and fluorescent lamps are often preferable when colored materials are being handled. Don't forget to have general room illumination at least one tenth as great as that from portable units.

*Study and reading.* Place a portable lamp at one side of the desk or chair, where it will not cast shadows or cause reflections from pages. Do not use a wall or ceiling fixture centered over a desk; place it at one side. The distance between bottom of lamp shade and work should not be over 24". Never place directly behind a chair a floor lamp used for reading. A bedside table lamp or wall unit should have the lower edge of the shade about 26" above the mattress.

*Fun and frolic.* For card tables, use portable lamps producing considerable upward lighting. If you have an old-fashioned bridge lamp, throw it away or spend 50 cents to modernize it with a 100-watt silvered-bowl lamp and a 25-cent conversion reflector, but don't depend upon it to light a bridge table. For table-tennis tables, use standard ceiling units protected by metal netting, lamps shielded by deep parchment shades, or units recessed into ceiling behind directional lens plates or metal baffles that keep the glare from the players' eyes. Fluorescent lamps lend themselves to recessed use in playrooms. Pianos can be lighted by floor lamps. A fluorescent music-page illuminator was introduced recently.

A recreation-room bar is a good place to try decorative lighting. An effective stunt is to install a glass-shelved cabinet for holding glasses and bottles, and illuminate it with lamps placed behind opal-glass panels at bottom or top. Living-room what-not cabinets can be lighted in same manner.

Good lighting requires adequate wiring. The usual No. 14 wire often is wasteful of

current because of heat loss. It is better to use No. 12 in all branch circuits, and No. 10 or bigger for all runs of more than 50' from panel board to first outlet.

Little circuit breakers at strategic points are the modern substitute for fuse plugs.

Double convenience outlets serve most flexibly when installed on or near the baseboard at 12' intervals of unbroken wall space in each active room, and in all wall spaces 3' or more long between door openings. Outlets should also be placed above work surfaces in kitchen, at built-in dressing tables, and at bathroom mirrors.

To provide a path of light ahead, place at each commonly used door either the new silent mercury switches or conventional wall switches. Other switches can control convenience outlets feeding portable lamps. In this case, use special double outlets wired so one half remains "hot" at all times to operate radios and vacuum sweepers.

The best time to lay out a lighting system is while the house is being built, but a surprising amount of lighting modernization can be done in any existing dwelling. When the owner does the work, he should keep it in accordance with the National Electrical Code and local building regulations.

It should be determined whether insurance regulations require inspection of such newly installed work. Failure to comply with requirements might jeopardize the insurance.

After you have up-to-date fixtures and portables, don't let them lose one fourth or more of their efficiency by becoming dirty. Wash lamp bulbs, diffusing bowls, and reflecting surfaces whenever they are dusty enough to show a slight mark from a finger rubbed over them.

And, finally, don't worry yourself gray—and maybe blind—because your lamps use electricity. For the cost of mailing two letters, a 100-watt lamp will provide you with light every evening for a week. Can you think of a better bargain?

## WHY READING TIRES YOU

In a day of continuous reading, the eyes travel over a mile of type and back; they recognize more than 100,000 words. The six tiny muscles guiding each eyeball make it take 100,000 steps—as many as your feet would take in walking 50 miles.

The eyes have over 130,000,000 tiny nerve connections—they outnumber the world's telephones by more than three to one.

The pupil of the eye becomes smaller with age; consequently there is need for more light as birthdays pile up.

If a child has to hold the book he is reading

closer to his eyes than 13" or 14", he probably needs eyeglasses or better lighting, or both.

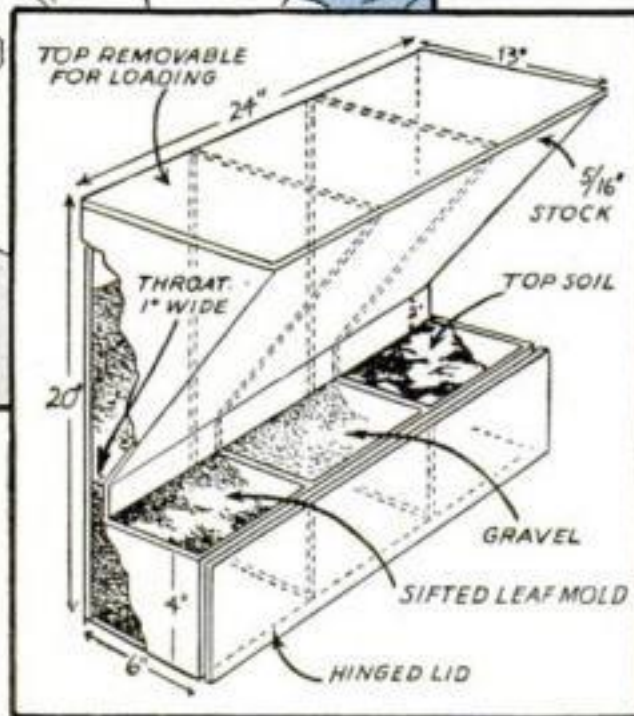
A man who uses his eyes under poor lighting conditions for prolonged periods frequently exhibits greater nervous muscular tension than a man digging a ditch.

Three times as much light is required for reading a newspaper as for reading a well-printed book.

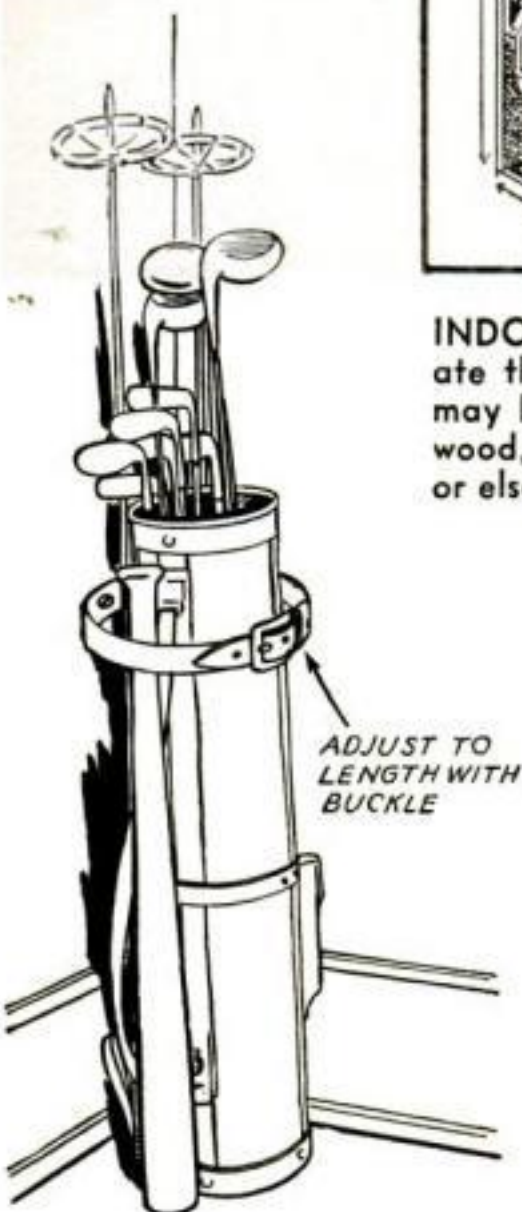
Reading when the page is brightly illuminated and the rest of the room is dim may cause unnecessary eyestrain and fatigue. Some of the light should go to the ceiling.



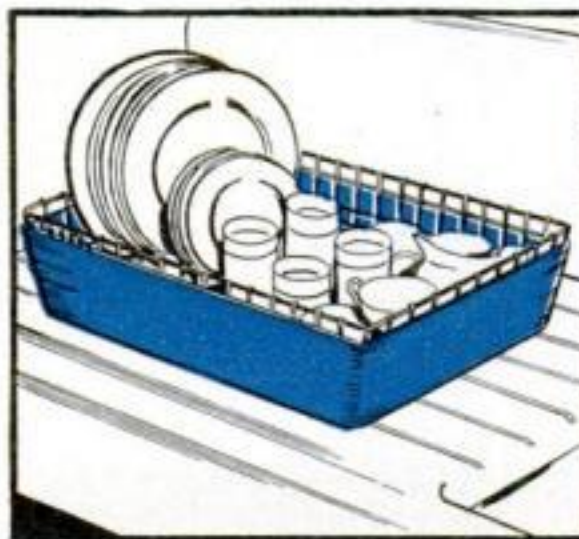
# KEEPING



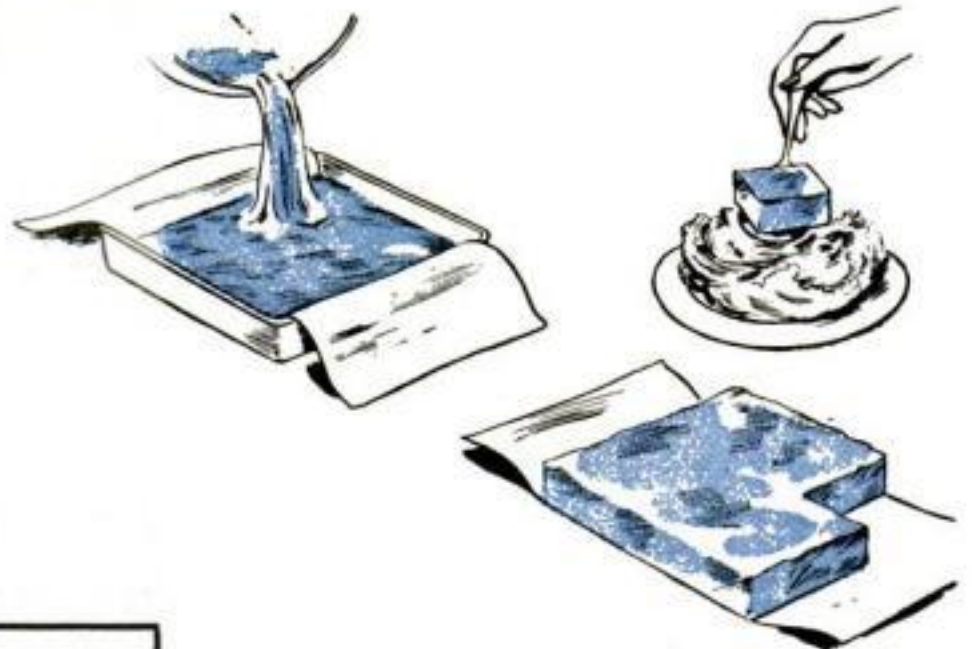
INDOOR GARDENERS will appreciate the useful hopper above, which may be built of sheet metal or plywood, hung on the wall of a porch or elsewhere, and painted as desired



GOLF BAGS, skis, and other long articles can be held upright in a corner of a room or closet by a strap screwed to one wall. Discarded belts and luggage straps are good enough to serve the purpose



RINSING DISHES in a wire drain basket often results in splashing and a wet floor. A section of inner tube (or a strip cemented end to end) stretched around the sides, will help to reduce splashing to a minimum



PERFECT SERVINGS of gelatin salads can be made by lining a flat mold with wax paper. Lift out the jellied salad by the paper ends, and cut it on the table



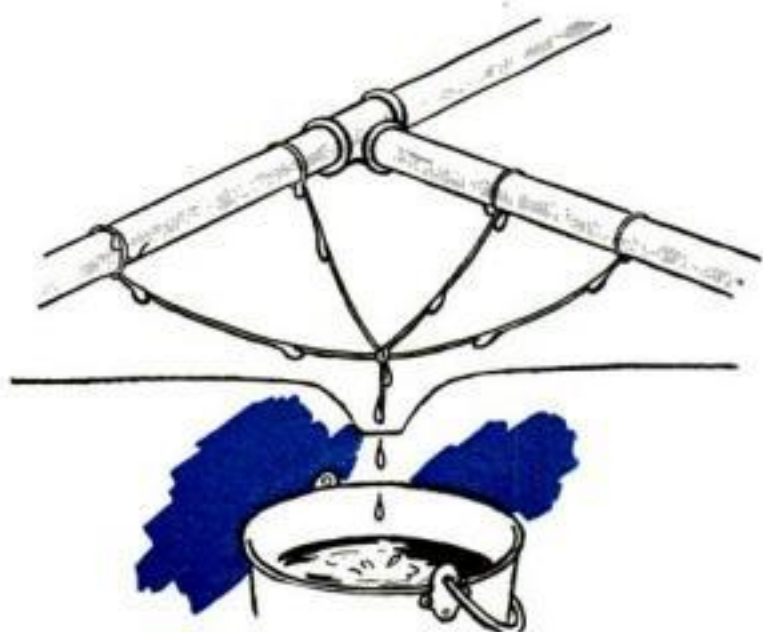
WHEN DEFROSTING a refrigerator, you will find it easier to remove the brimful drip pan if you turn on the unit and first allow a thin film of ice to form over the water



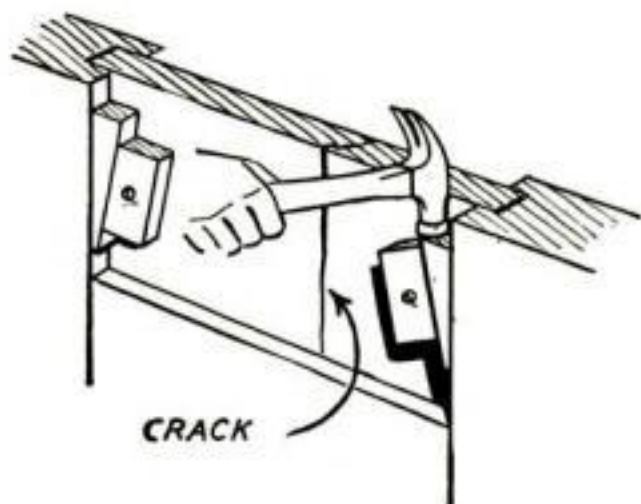
PAINT-CAN COVERS should be replaced tightly to preserve the contents, but paint often squirts from the rim when this is done. To prevent spattering, press the lid down with a larger cover or a pie tin inverted over it as above



# THE HOME SHIPSHAPE



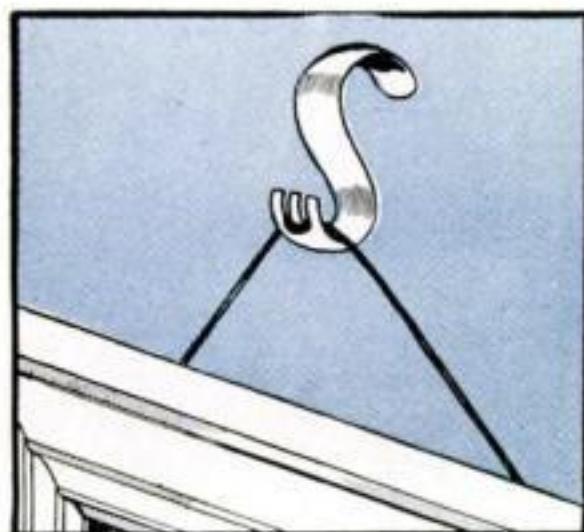
TO PREVENT drip spots under sweating pipes, tie cords wherever drops form and connect them over a bucket. Roof leaks under which pails cannot be put may also be controlled in this way



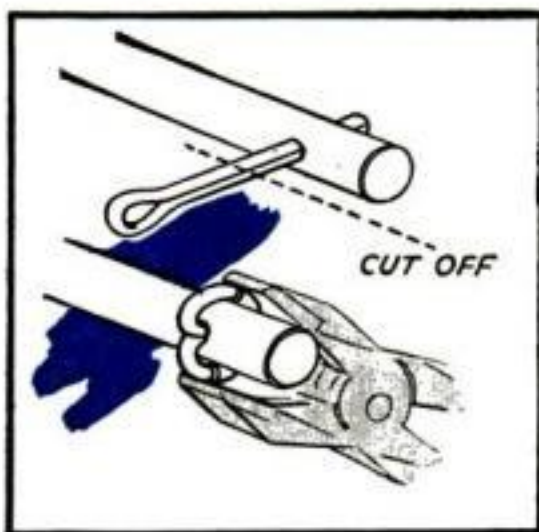
A SPLIT DOOR PANEL can often be repaired as above. Screw blocks fast near the frame and run glue into the crack. Drive in wedges. When glue has set, remove blocks and fill the holes



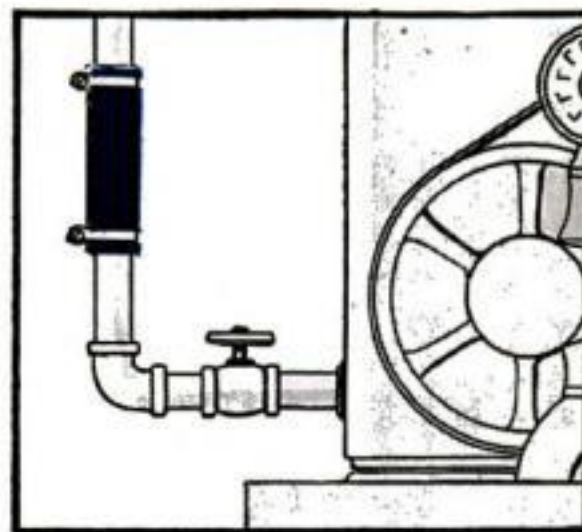
IF A FUSE BLOWS when you are alone, it may be hard to know when the right one is replaced, especially if the fuse windows are clouded. To avoid running upstairs frequently, plug a radio into the dead circuit. Substitute a good fuse for each one in turn until the radio is heard



PICTURES HUNG from a single hook of the type shown are more likely to remain straight on the wall if two slots are sawed in one end of the hook and the picture wire then threaded through them in the manner illustrated



COTTER PINS may be used to form stop collars around shafts of kitchen appliances and other mechanisms. Drill a hole in the shaft, insert a pin, cut off the head, and bend both the prongs around



NOISE AND VIBRATION from a water pump can be prevented from traveling along the pipes into other parts of the house by inserting a short rubber-hose coupling between the house plumbing system and the pumping unit



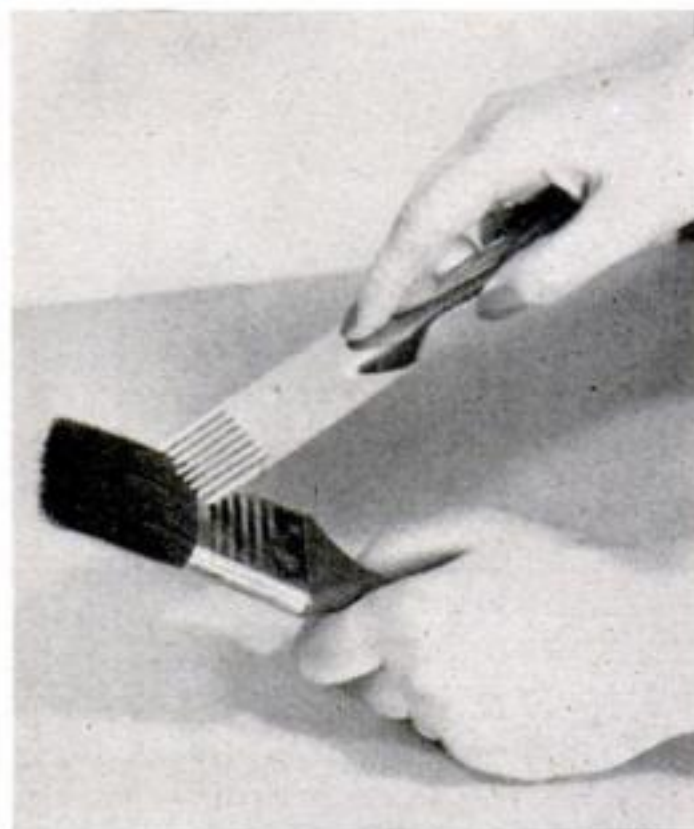
# IDEAS for HOME OWNERS

**ROOFING SHINGLES** of asbestos cement are now made with the texture and grain of fine weathered woods, and in red, green, and blue-black color blends as well as natural gray and white. The prefabricated strips have clean-cut shadow lines, cover the same roof area as asphalt strip shingles, and, it is said, can be laid almost as quickly. The asbestos-cement shingles are fireproof, cannot rot or decay, and remain unaffected by exposure in any type of climate. They may readily be applied over old roofs as well as to new construction, and harmonize well with nearly all types of architecture.



**AN EXTREMELY SIMPLE** and inexpensive garden-hose nozzle now on the market consists of a standard threaded coupling attached to a soft rubber cone, at the apex of which is a small hole. It throws a round stream of water, which can, however, be changed instantly to a spray by pressing against the side of the cone with one finger. There is no leakage of water from the collar, as may occur with some nozzles when they become worn.

**IF A PAINTBRUSH** has become caked and hard through neglect, it may be possible to save it for further use by stroking it with a new stainless-steel comb designed for the purpose. The action of the eight teeth is to render stiff bristles soft and flexible once more. The comb should be used with a liquid brush softener or a solvent of some kind.



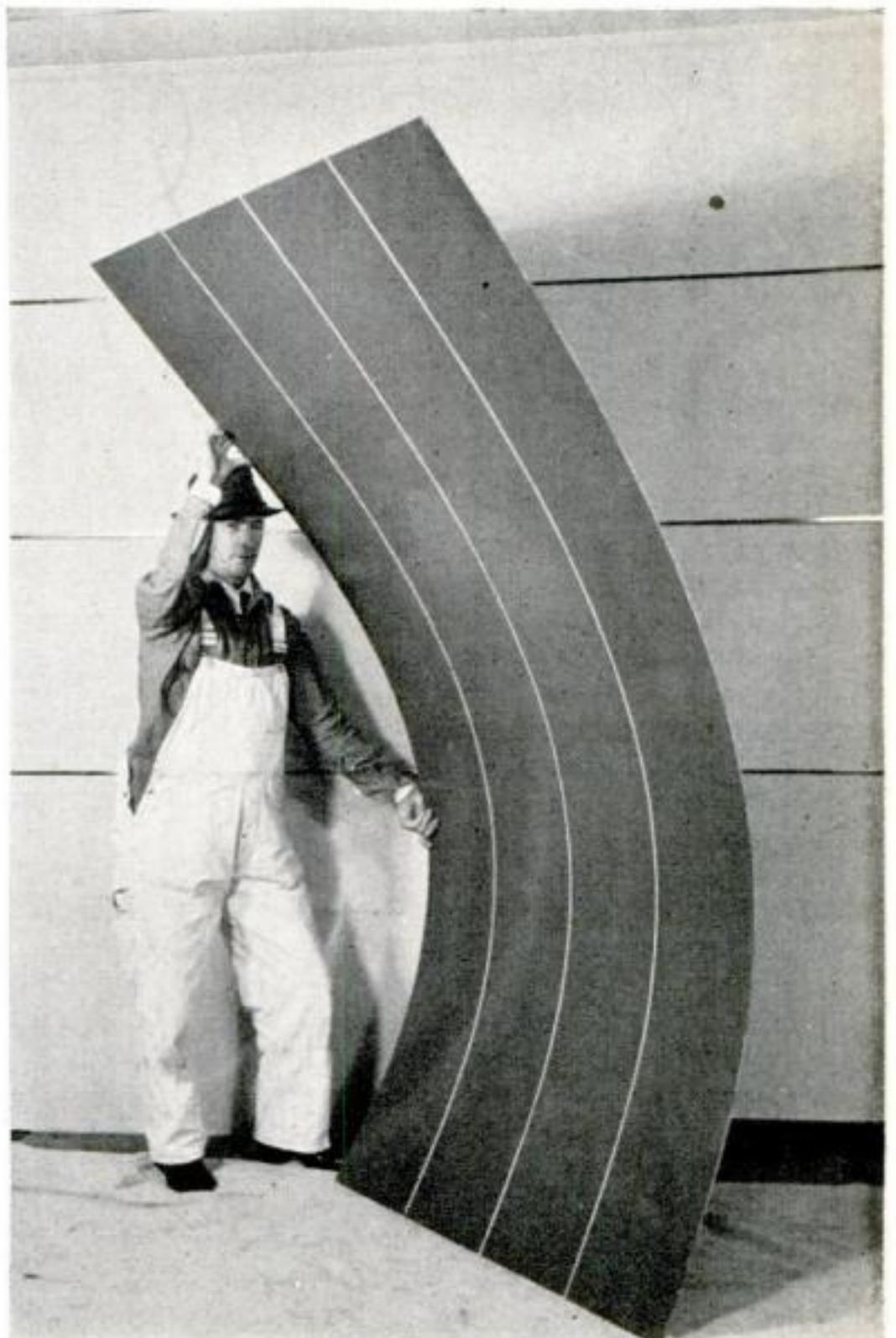




**FIRE-RETARDING DOORS** are often wedged or otherwise held open, and their intended purpose during emergencies thereby defeated. A thermally operated door closer now available may be attached to a standard door check as shown, and normally holds the door open if the latter is swung back 90 deg. or more. The latch is a spring-actuated plunger, held back by a small liquid-filled bulb clamped in a metal frame as in the photograph. If the temperature rises to 135 deg. Fahrenheit, the liquid expands sufficiently to burst the bulb, and the plunger, thus released, allows the door check to shut the door.

**PREFINISHED ASBESTOS-CEMENT WALL BOARD** of the flexible variety can now be purchased in any of eight colors—blue, green, peach, yellow, red, ivory, black and white—for use in new construction or remodeling old buildings. Its high-gloss finish is said to be remarkably stain resistant, and its asbestos-cement base has been waterproofed to prevent moisture penetration through the back and edges. Standard sheets are 4' by 8', plain or with horizontal scoring, and 4' by 4', with 12" by 12" box scoring.

**A NEW DEODORIZER** for use in garbage cans is inclosed in a metal container by which it may readily be attached to the underside of the can cover as shown below. Its volatile substance yields a strong but not unpleasant odor that will, it is claimed, repel flies and other insect pests as well as dogs and cats that might otherwise knock the can over in search of food. Being nonpoisonous, it will not harm pets even if they should accidentally eat it.





# New Walls for Old

EASY-TO-FOLLOW DIRECTIONS FOR  
REDECORATING WITH WALL PAPER

## PART II

**I**F THE ceiling paper has been hung as described in the first installment of this article (P.S.M., Aug. '41, p. 140), you are ready to proceed with papering the wall.

Before cutting the paper to lengths, study the pattern and margin markings so as to be able to cut it with the least possible waste. Wall papers are classified as "straight" and "drop-figure" papers. On their margins you will find markings which indicate where the pattern should be cut. The straight-figure paper shown in Fig. 20 matches immediately opposite the same part of the pattern on the adjacent strip, and therefore all lengths

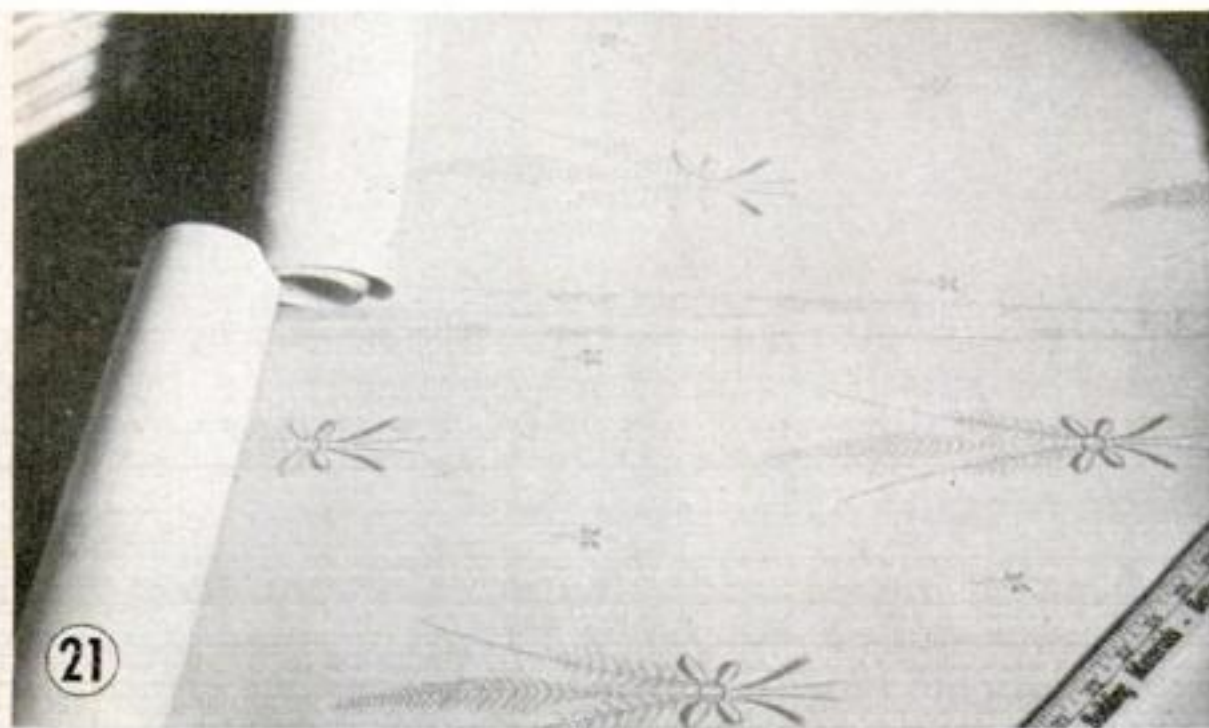
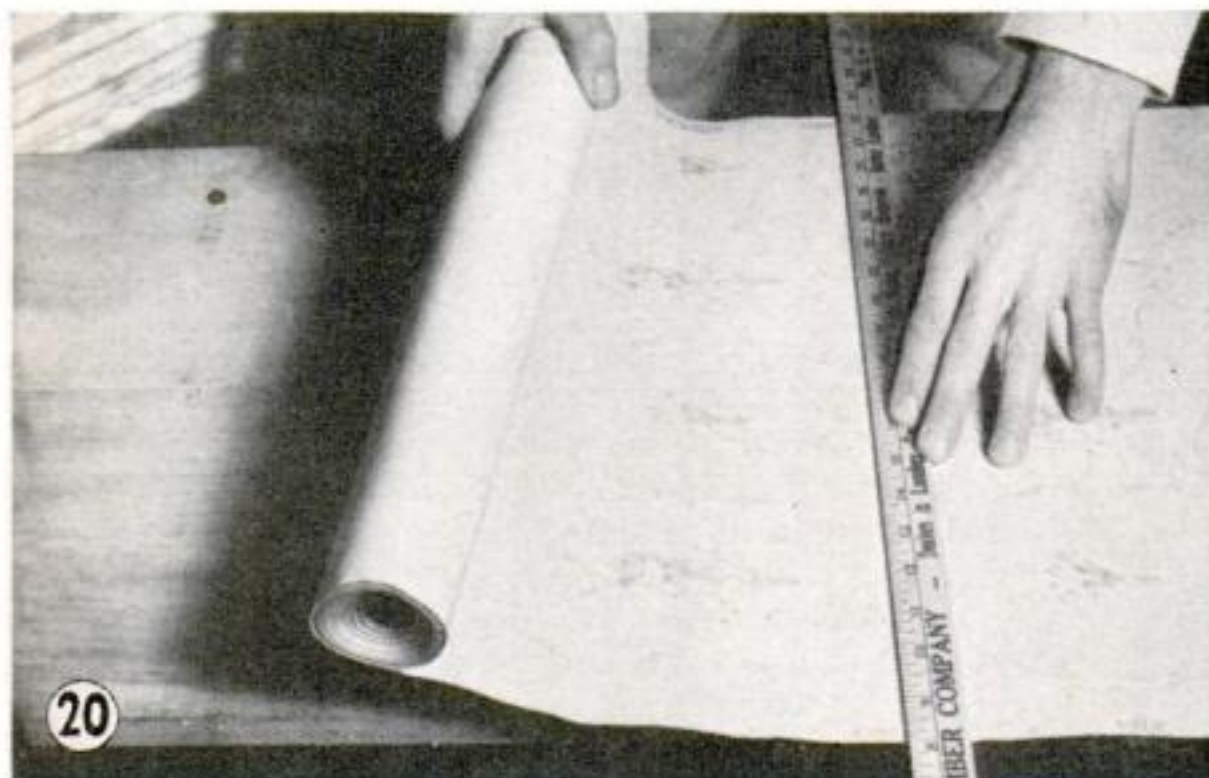
are to be cut on the "join here" marks.

A drop-figure paper, such as a floral design usually is, will not match immediately opposite, but must be dropped or moved downward in order to match the adjacent strip. An example of drop-figure matching is illustrated in Fig. 21. The drop measures one half of the full figure, and the paper must be cut accordingly. You will cut one strip the required length by cutting on the "join here" mark, and the next strip by cutting halfway between the "join here" marks. It simplifies matters and saves material to cut from two rolls of paper instead of one—

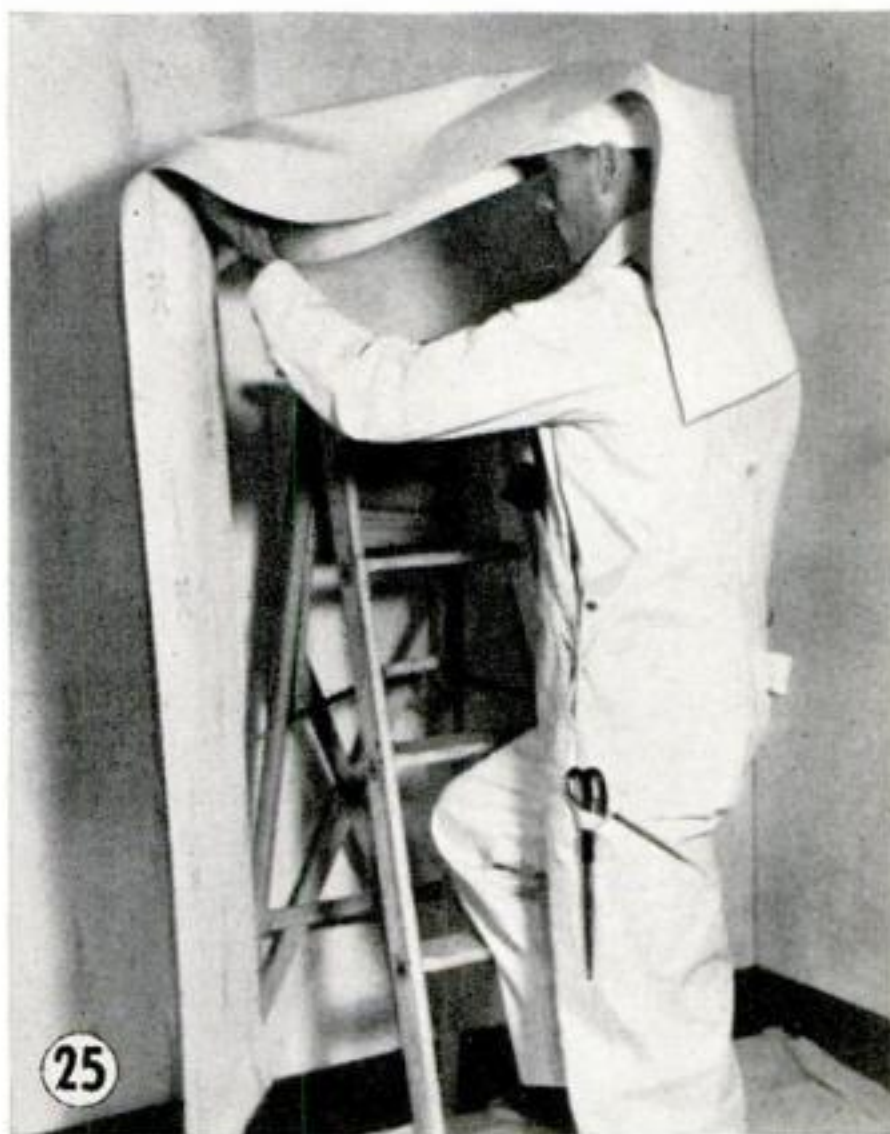
on the marks from one roll and between the marks from the other.

In cutting the strips, a deduction may be made for the border at the top of the room, but the strip should be made long enough to extend beyond the top of the baseboard, where it is trimmed smoothly, as in Fig. 26, as soon as the hanging of each strip is completed. Use your rotary trimmer for this operation and a clean cut will result. If a soft cloth is kept handy, it is an easy matter to wipe any excess paste from the edge of the baseboard and casings before it has a chance to dry and harden.

In hanging the first strip of side wall, the initial consideration is to have it plumb. When using ordinary 18" paper, start 18" in from the corner of the room (Fig. 13 in last month's article), and hang from a small brad (as in Fig. 22), a plumb line which has been rubbed with carpenter's blue chalk. Hold the line just above the baseboard and snap it







as shown in Fig. 23 to transfer a chalk mark to the wall as a guide line. The starting strip is hung to this line (Fig. 24).

Another simple aid in hanging the first strip plumb is to stick a pin in the marked line near the bottom. Hang the strip from the top, letting its lower edge just touch the pin. Figure 25, awkward as it may look,

shows an easy method for a beginner to handle limp pasted paper while mounting the stepladder.

In last month's article you were cautioned to begin work on the ceiling from the light side of the room so as to prevent the casting of shadows at the seams. This is also the principle to follow when using lap-type





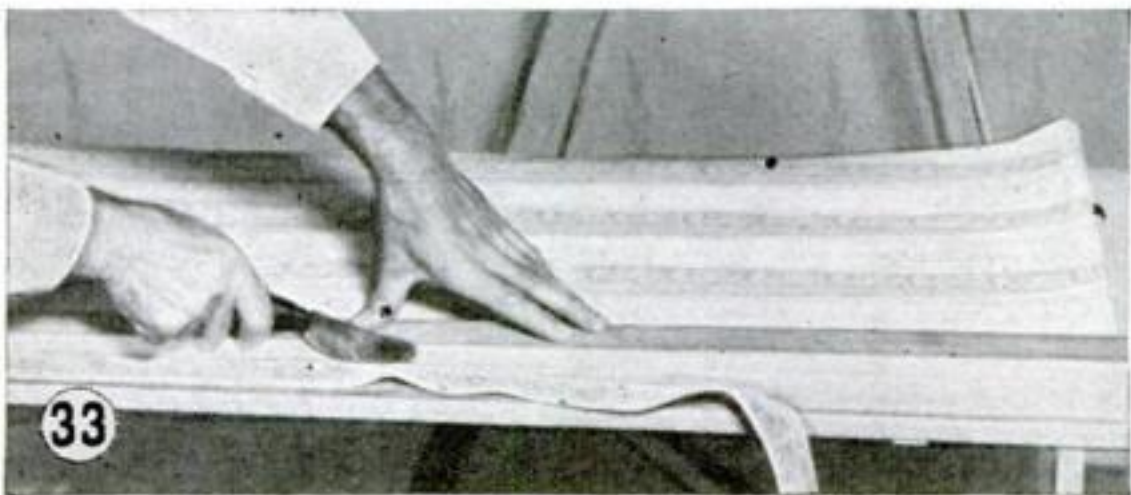
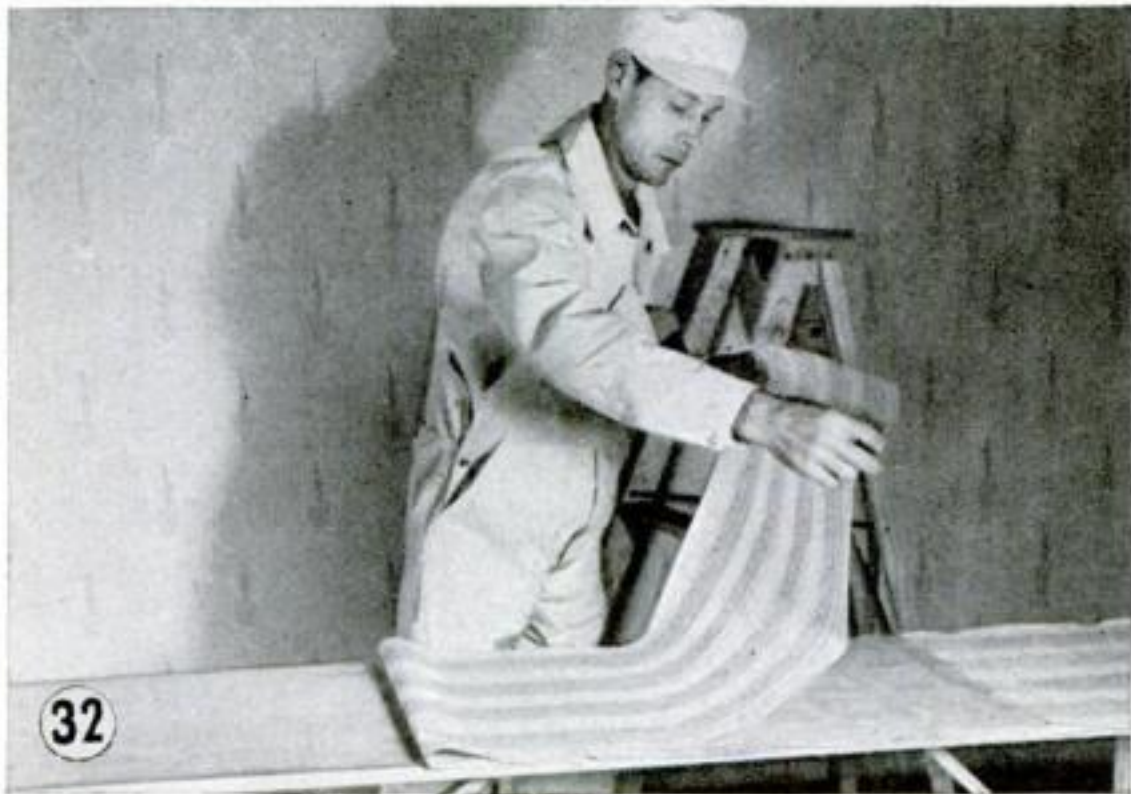
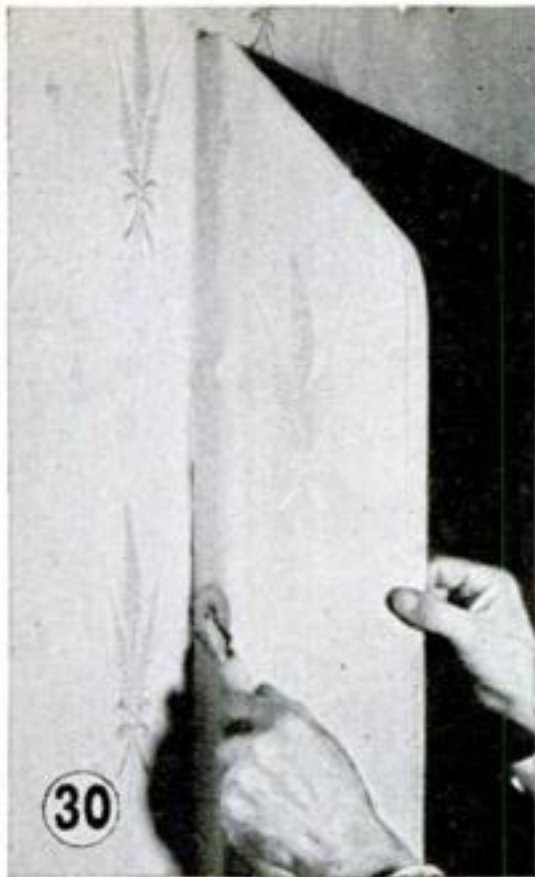
seams in papering the side walls, but in this instance you must remember that you have two light sides instead of just one. In the case of a room with windows on only one side, you should therefore start papering from the windows toward the rear on the two walls adjacent to that containing the windows. In the case of a room with windows on two adjacent walls, you may start at the corner formed by the two walls having windows, paper two walls, then return

to paper the other two from the same corner.

Not infrequently the paper pulls loose at the corners of the room. Here is a simple trick to forestall this: As you approach a corner, take the paste brush and apply a coat of paste in the corner angle as in Fig. 27. This additional paste helps to hold the paper securely in place.

Do not attempt to carry a full-width strip around the angle of the corner, for it will invariably wrinkle. Instead, use a fill-in,





cutting the strip so that the lap is in the corner, as is being done in Fig. 28.

At windows and at door casings, the pasted length should be applied as in Fig. 29, crowded to the casing, then carefully trimmed with the rotary trimmer as in Fig. 30.

Switch plates, furnace thermostats, and similar wall fixtures should be loosened to assure neatness in fitting the paper around them. Remember to let hung paper absorb the paste a short time before you start roll-

ing the seams, as was suggested in the first part of this article. Figure 31 illustrates the use of the seam roller.

Borders come in sheets having four or more strips to the sheet. The simplest way of handling is to paste the entire sheet and fold it back as in Fig. 32. Then, with straightedge and knife, trim it carefully and accurately as shown in Fig. 33. Start hanging the border in an obscure corner and go the whole way around the room.

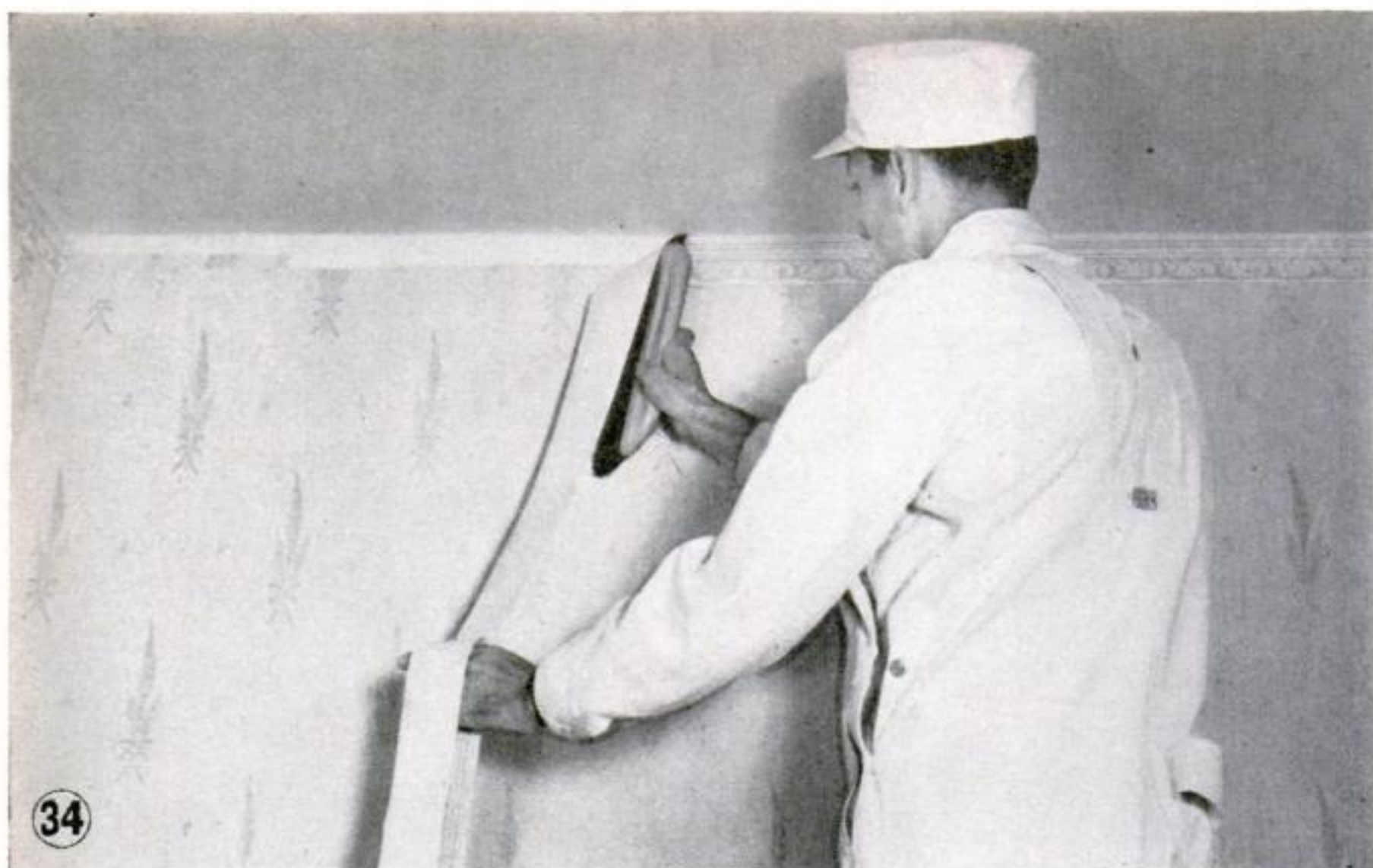
Some borders have a prominent pattern and the design may not be matched at the end joint, therefore this will be less noticeable if you have started in the most inconspicuous corner. The process of hanging the border is shown in Fig. 34.

Varnished-surface papers are widely used for kitchens and bathrooms, as they are highly practical because they can be easily cleaned with a damp cloth. However, amateurs may have trouble with wrinkling unless a few simple precautions are observed.

The first thing to remember is that if this type of paper is permitted to stretch before being applied to the wall, troublesome wrinkles will not result. A strip should be pasted, folded, and laid aside, then a second strip treated in the same manner. Meanwhile there will have been sufficient time for some of the paste to have been absorbed by the first strip, and it may be hung while the second is waiting. As a result of this absorption, the paper stretches slightly. After it is applied to the wall, it shrinks back a trifle in the drying process, and this eliminates any possibility of wrinkles occurring.

Another little trick some paper hangers employ is carrying a number of finishing nails in a pocket. Upon reaching the places where pictures or shelves have been removed and are to be rehung, the finishing nails are inserted in the holes from which the old nails or screws have been taken out. These nails protrude through the new paper and make it easy to locate the original positions later for rehanging the articles. This eliminates the bother of hunting for the original locations through the





new wall paper, and the possibility of missing the lath and further damaging the wall.

Frequently it is necessary to apply a patch to a papered wall. The feather-edge patch illustrated in Fig. 35 makes an inconspicuous repair. The design of the paper to be patched should be matched as closely as possible, and the patch torn as in Fig. 36.



### Roll-Roofing Cement Spread by Using Rim of Can

WHEN roll roofing has to be laid, a neat job of applying the lap cement can be done by using the can itself as a spreader. Punch a hole in the top of the can near the rim with a ten-penny nail, and heat the can for a few minutes in hot water. Then punch four holes  $\frac{1}{2}$ " apart close to the edge on the opposite side. Hold the can upside down and touching the roofing, so that the rim will spread the cement as it runs out of the four holes. This spreads the cement evenly and quite rapidly.—A. LAFORGE.



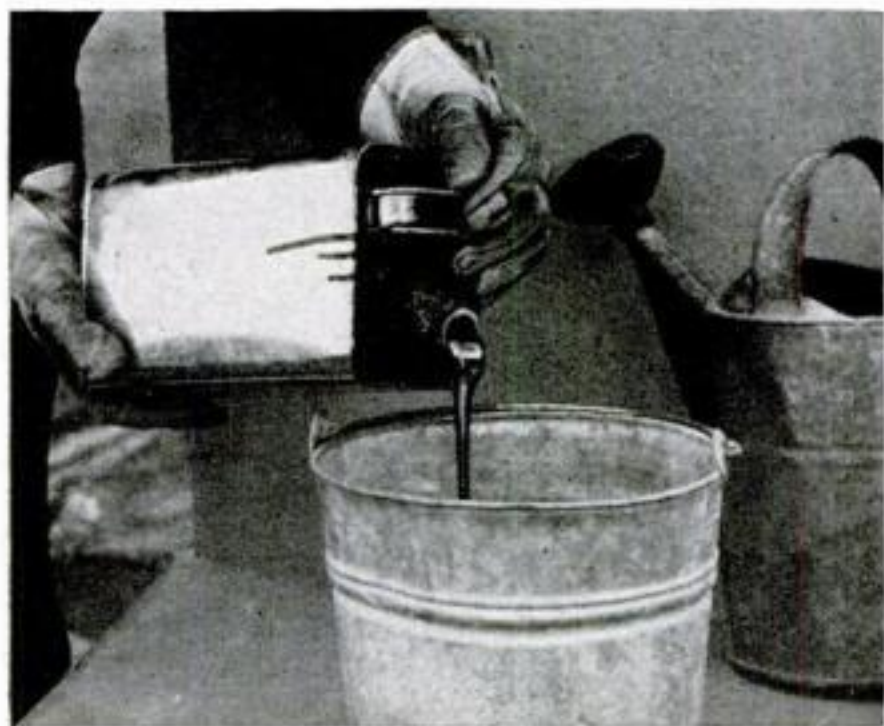
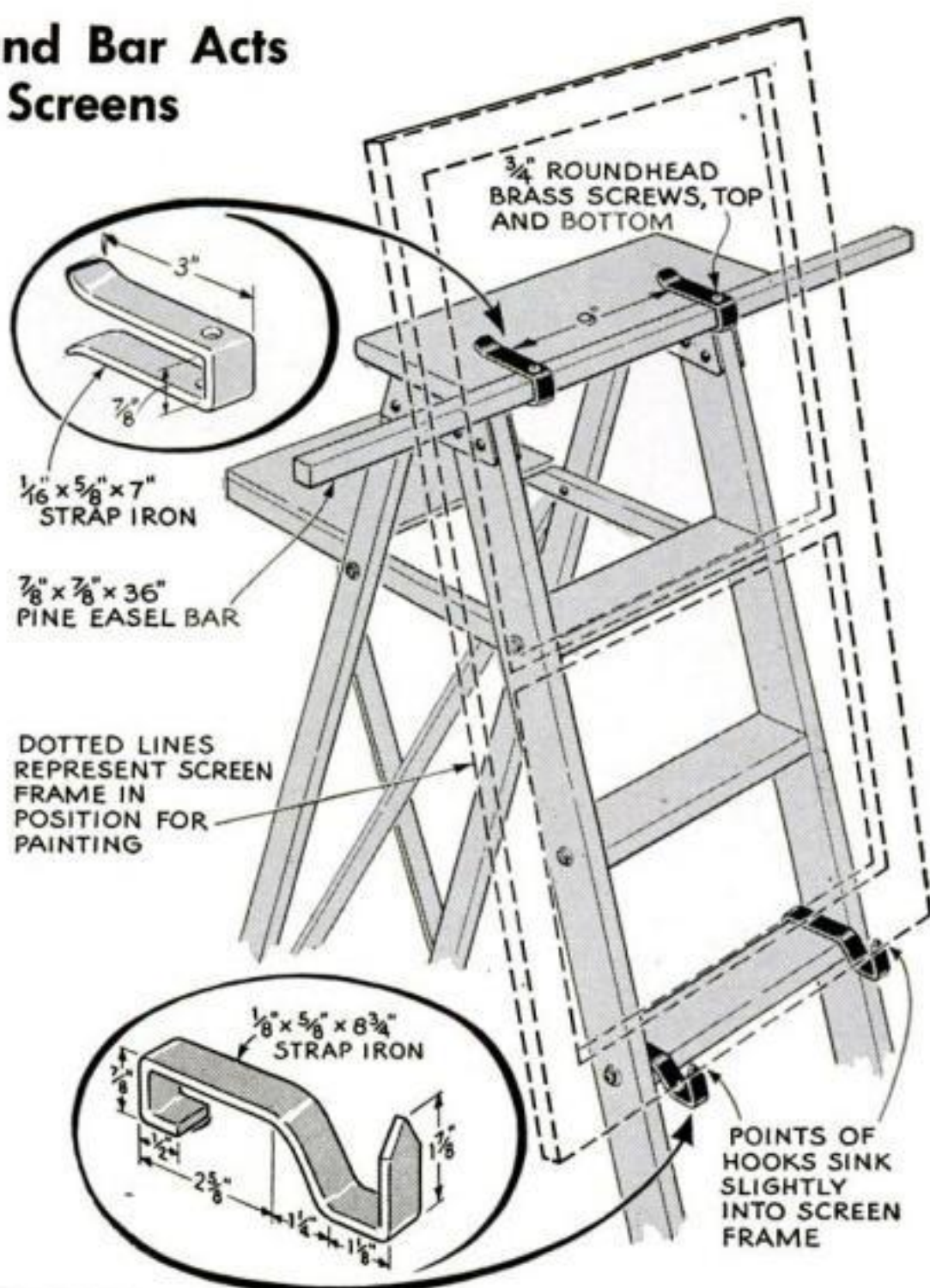
## Stepladder with Hooks and Bar Acts as Easel for Painting Screens

BY MAKING the simple attachments shown, you can convert a common stepladder into a satisfactory easel for painting or washing screens and storm sash. The strap-iron parts can be formed with vise and hammer, or any blacksmith or small machine shop will make them at reasonable cost.

The two pieces shown in the lower detail hook over a step and hold the bottom of the screens or storm sash. They allow the bottom edge to be painted. Note that the points are ground off somewhat abruptly in order to avoid unnecessary penetration of the wood.

The long wooden bar is held across the ladder farther up for the screen or sash to rest against. This crossbar may be padded with cloth, if desired.

The only precaution to observe is to avoid using the easel outdoors on a windy day, when the screens might be blown off the easel.—M. W. MUTSCHLER.

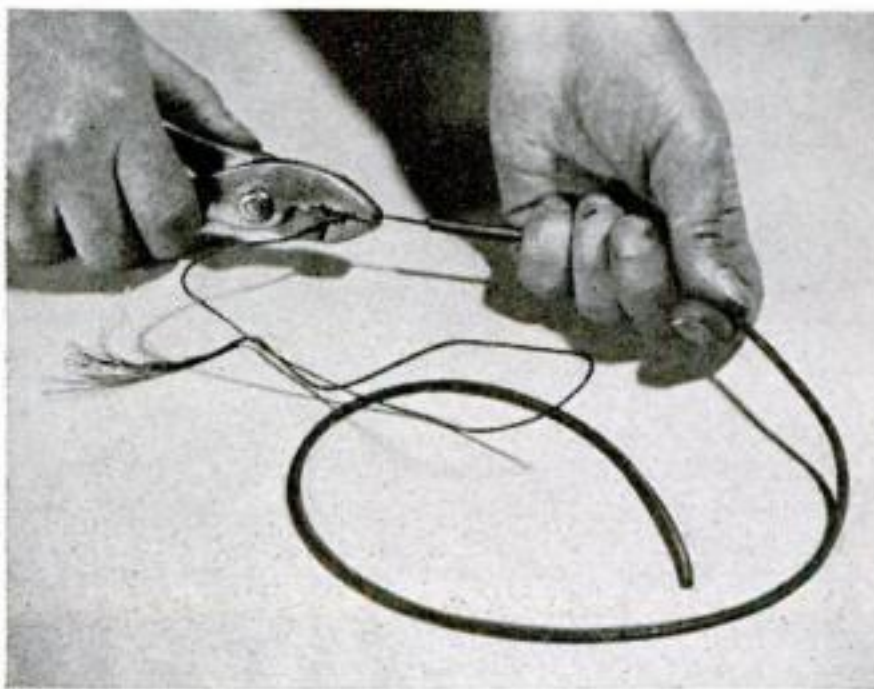


## Leaks in Water Pails Sealed with Asphaltum Paint

SMALL holes in the bottoms of water pails, sprinkling cans, and other water containers not subjected to heat can be sealed by pouring in a small quantity of asphaltum paint. The heavy consistency of the paint causes it to congeal before any appreciable amount flows out of the holes. Keep the pail level until it dries.—J. M.

## Rubber-Covered Lamp Cord Supplies Small Tubing

SHORT lengths of small-diameter rubber tubing of great strength and elasticity can be obtained from rubber-covered lamp cord. Cut the wire to the approximate length desired, and clear one end of insulation for a firm grip with a pair of pliers. The rubber cover can then be worked off gradually by hand as shown below.—K. M.





# 3,307 Readers Tell Us What Kind of Home They Want

**H**UMAN interest of the most appealing type is written all the way through the 3,307 entries received in our \$1,000 house-planning contest. As the judges reviewed, one by one, the plans and the voluminous accompanying specifications, they discovered all sorts of side lights on the home-building needs of our readers.

With unbounded courage, a woman in bomb-torn England sent plans of the house she hopes she and her husband will live to build for their children. A prisoner in San Quentin, Calif., submitted an excellent entry, and there was another from an inmate of the Federal prison at Leavenworth, Kans. A chief yeoman in the United States Navy offered his dream home. There was an entry from Batavia-Centrum, Netherlands East Indies, mailed in Java by Clipper plane, and censored. Sixty-three entries came from Canada, four from Hawaii, two from South America, one from Japan, another from Cuba, three from Alaska, and three from Puerto Rico.

In a letter accompanying her plans, Mrs.

I. C. Jacobi, Eynsham, Oxon, England, wrote:

"Having spent several weeks in bed recently, I found diversion in planning a future home to be built after the war is over and every one can think again of planning for a future, at least for the children. . . . I choose the bungalow type, as I hate stairs and want to be independent of servants. . . . Important for me is the room where I can retire. Two other points I cherish very much are: dining and sitting room next to each other, connected by a sliding door; and entry to the bathroom from the bedroom. . . . As I want this house to last for centuries, only the best materials shall be used, and I want as much craftsmanship and as little machine-made goods as possible."

By all odds the most unusual house in the contest was a circular design of rammed-earth construction, with decklike roofs, submitted by a New York contestant.

An ultramodern, low-cost design was submitted by a Florida contestant. Among the features he included were a living room with a sloping ceiling and a unique ventilating system (illustrated on the facing page), a combination bedroom and workshop, a solar

As each entry was opened, an identifying number was marked on all the sheets, and an index card prepared







Many beautiful drawings were submitted. This is by W. G. Cleland, Jr., of Mt. Lebanon, Pa.

heater on the roof for water, a sun deck over the garage, and fluorescent lighting throughout.

One woman submitted plans for what she called her "We Are Seven" House." Her problem, as she expressed it, was "to design a house of honest materials, pleasing and restful in appearance, well planned for the privacy and convenience of each member of a family of seven, and designed to lighten upkeep and cleaning bills."

Here are a few extracts from contestants' letters:

"Boiling the whole thing down, it is seen that a design for a house is noteworthy only when it satisfactorily answers the questions: Does it have beauty? Is it livable? Will it perform?"—W.G.C., Mt. Lebanon, Pa.

"Although this is a last-minute entry, it is by no means a last-minute plan. For months I have practically lived in this house—walked through it in my dreams. It is also exactly what we want . . . what we need . . . and best of all what we can afford."—Mrs. M.L.L., Dansville, N. Y.

"If you enjoy the plan as much as I do, I'm certain that I'll win first prize, but it's not the prize I'm after; it is the pleasure I get from it, and some day soon I hope that making

dream castles for others will be my vocation, not avocation."—F.K., Northfield, Minn.

"I had no idea of the work the contest entailed, but I can honestly say I enjoyed every bit of it."—D.S.R., Detroit, Mich.

A complete report on the contest, with a list of the winners, will appear in the October issue of POPULAR SCIENCE.



Ultramodern living room planned for a small home near Miami, Fla.



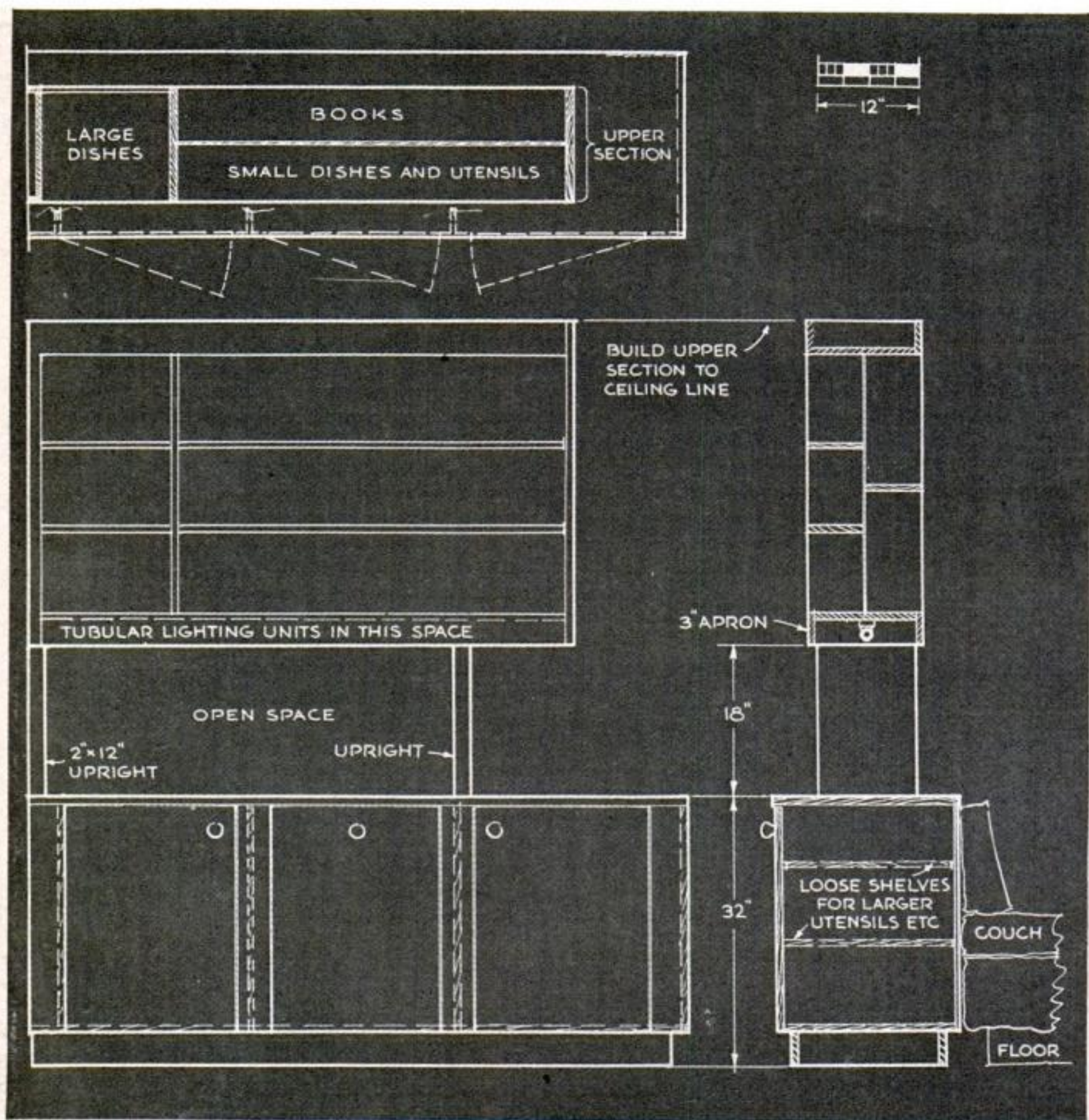
# Utility Cabinet Forms Couch Alcove

DESIGNED AND ILLUSTRATED

**P**ARTITIONS are easily built to subdivide a large room, but this cabinet unit, which is about as simple to construct as an ordinary section of wall, serves as an excellent yet unobtrusive partition. In addition, it lends an element of beauty and, like all good modern household furniture, embodies the utmost utility in its clean-cut design.

The cabinet effectively divides off a portion of a large living room in a week-end

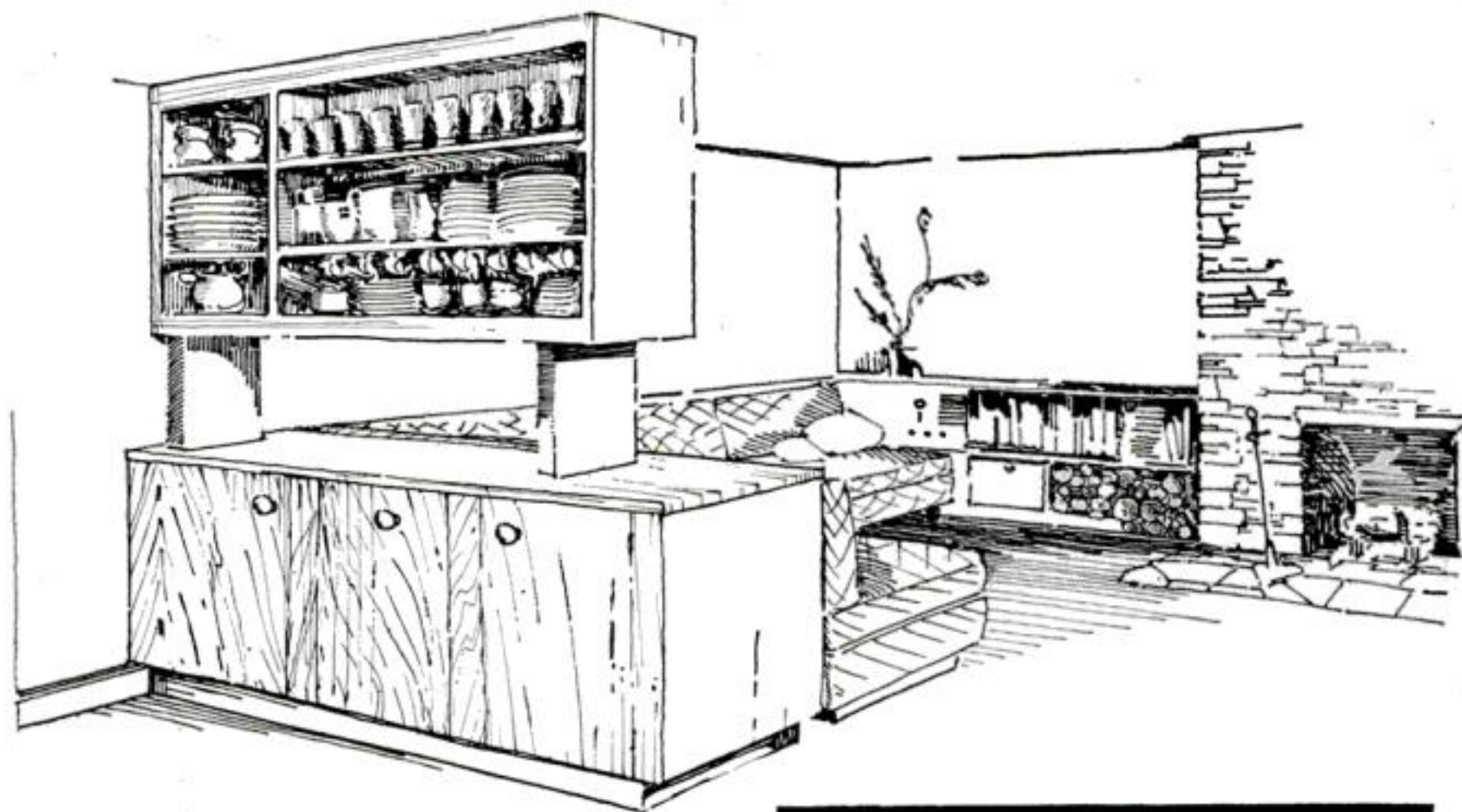
cottage by forming a twin-bed alcove for the accommodation of overnight guests. By day, the two studio couches behind it are used as a corner lounge; at night, one of them is swung out parallel to the other, alongside the fireplace wall. Not only does the cabinet act as a screen, but also as a couch back, a bookcase, and a dish closet. The lighting fixtures that illuminate the working area of the counter top, and the





# for Week-End Cottage

BY JOSEPH ARONSON



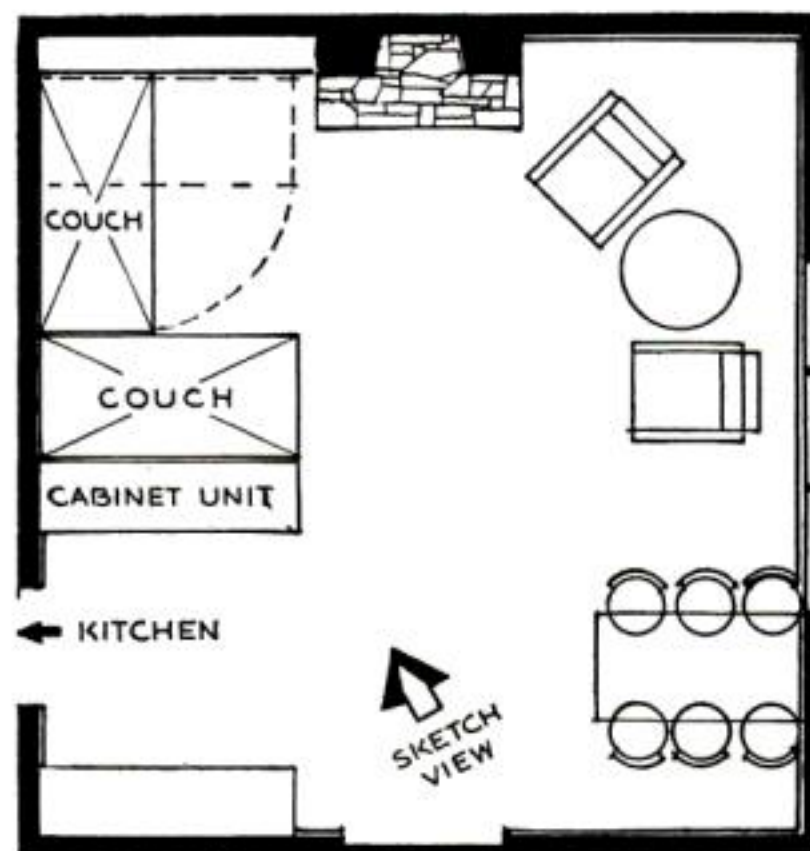
Dishes and glasses are displayed on one side of the top shelves, books on the other. The working counter is well lighted, the storage space deep

nearer couch and alcove as well, are built directly into it.

Redwood boards were used for the original cabinet, and finished with a thin coat of shellac. The lower portion measures 22" by 78", and is 32" high to the counter top. The doors are of board-and-batten construction, and the back is a  $\frac{1}{4}$ " fir panel stained to match the redwood.

The upper section is built 18" above the base and up to the ceiling, being supported by 2" by 12" uprights. The shelf section nearest the wall is the full depth of the upper section (14"), and is for deep dishes, dinner plates, and similar large pieces of dining ware. The remainder of the upper section is divided vertically by a  $\frac{1}{4}$ " panel, on the kitchen side of which are kept dishes. The fireplace side is reserved for books.

The underside of the top section houses tubular "lumiline" lighting fixtures (fluorescent tubes might also be used) and is fitted with a 3" apron. This arrangement results in effective down lighting over the working



Couches are at right angles during the day, but one is moved at night to form twin beds

area of the counter top and the nearer couch.

Another desirable feature in the room illustrated is the low wall unit beside the fireplace. This consists of bookshelves and a firewood box that may be filled from outside the house.

The cost of all material for this project—lumber, hardware, and lighting units—will total about \$20 in most parts of the country.



# End Table

IN STYLE OF ANTIQUE LIBRARY STEPS

BY JOSEPH ARONSON

Author of *The Encyclopedia of Furniture*

INTERIOR decorators have recently started a vogue for using as end tables the library steps that survive from the early 1800's. These steps were, as a matter of fact, generally used for climbing into the high beds of those days. Today they are proving equally adaptable for use in the living room, and are often arranged with a lamp on the top step. Books, magazines, smoking accessories, and a telephone may be kept on the lower levels.

This design, meant to be constructed of mahogany, was copied from an American Empire antique, and presents no special problems other than the necessity for careful joinery and good finishing. First turn

the legs from  $2\frac{1}{2}$ " stock, and assemble the base part complete. Note that the back and sides are set in  $\frac{1}{16}$ " from the squares of the legs. The drawer slides on a frame of  $\frac{7}{8}$ " by 2" strips.

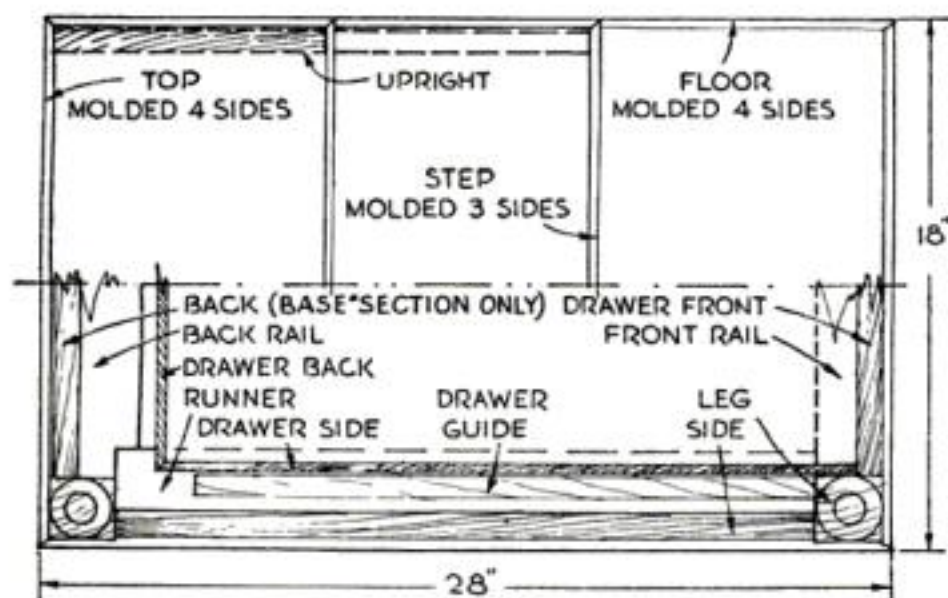
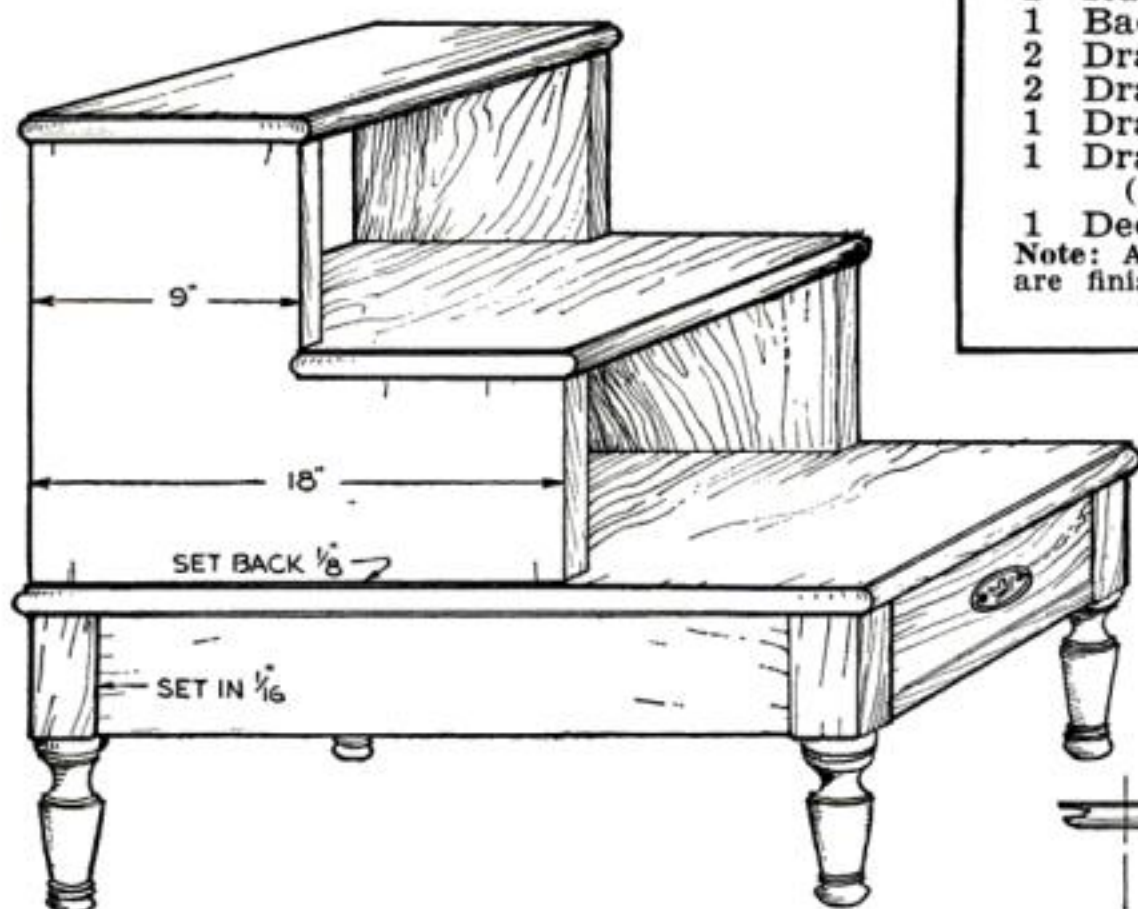
The back is left open above the floor, and the back edge of the middle step is flush with the uprights. The top step, however, is molded on four sides. Dowel these two steps to the uprights, which are set back  $\frac{1}{8}$ " from the edges of the floor.

If mahogany is not available, walnut, maple, birch and gumwood are satisfactory.

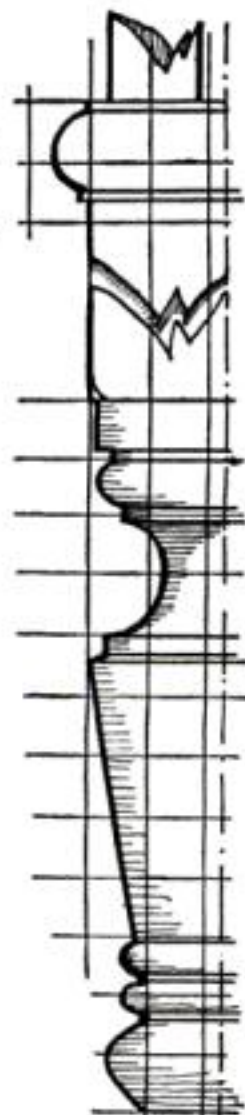
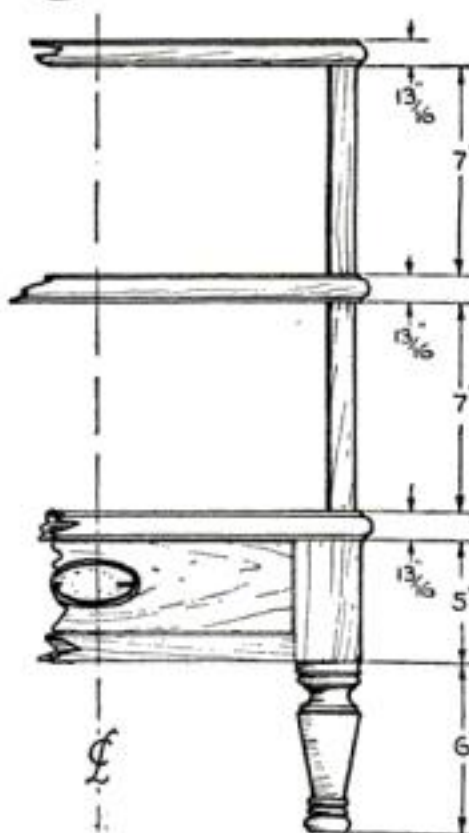
## MATERIALS

No. Pc.	Description	T.	W.	L.
1	Top	$\frac{13}{16}$	$9\frac{3}{4}$	18
2	Uprights	$\frac{13}{16}$	$14\frac{13}{16}$	18
1	Step	$\frac{13}{16}$	18	$18\frac{3}{4}$
1	Floor	$\frac{13}{16}$	18	28
1	Back	$\frac{13}{16}$	5	$12\frac{3}{4}$
1	Drawer front	$\frac{13}{16}$	$4\frac{1}{8}$	$12\frac{3}{4}$
4	Legs	$2\frac{1}{4}$	$2\frac{1}{4}$	11
2	Sides	$\frac{13}{16}$	5	$22\frac{3}{4}$
1	Front rail	$\frac{7}{8}$	$2\frac{1}{4}$	$12\frac{3}{4}$
2	Runner strips	$\frac{7}{8}$	2	$22\frac{3}{4}$
1	Back rail	$\frac{7}{8}$	2	$12\frac{3}{4}$
2	Drawer guides	$\frac{7}{8}$	$\frac{7}{8}$	21
2	Drawer sides	$\frac{1}{2}$	$4\frac{1}{8}$	24
1	Drawer back	$\frac{1}{2}$	$3\frac{1}{2}$	$12\frac{3}{4}$
1	Drawer bottom (plywood)	$\frac{1}{4}$	$12\frac{1}{4}$	24
1	Decorative brass handle			

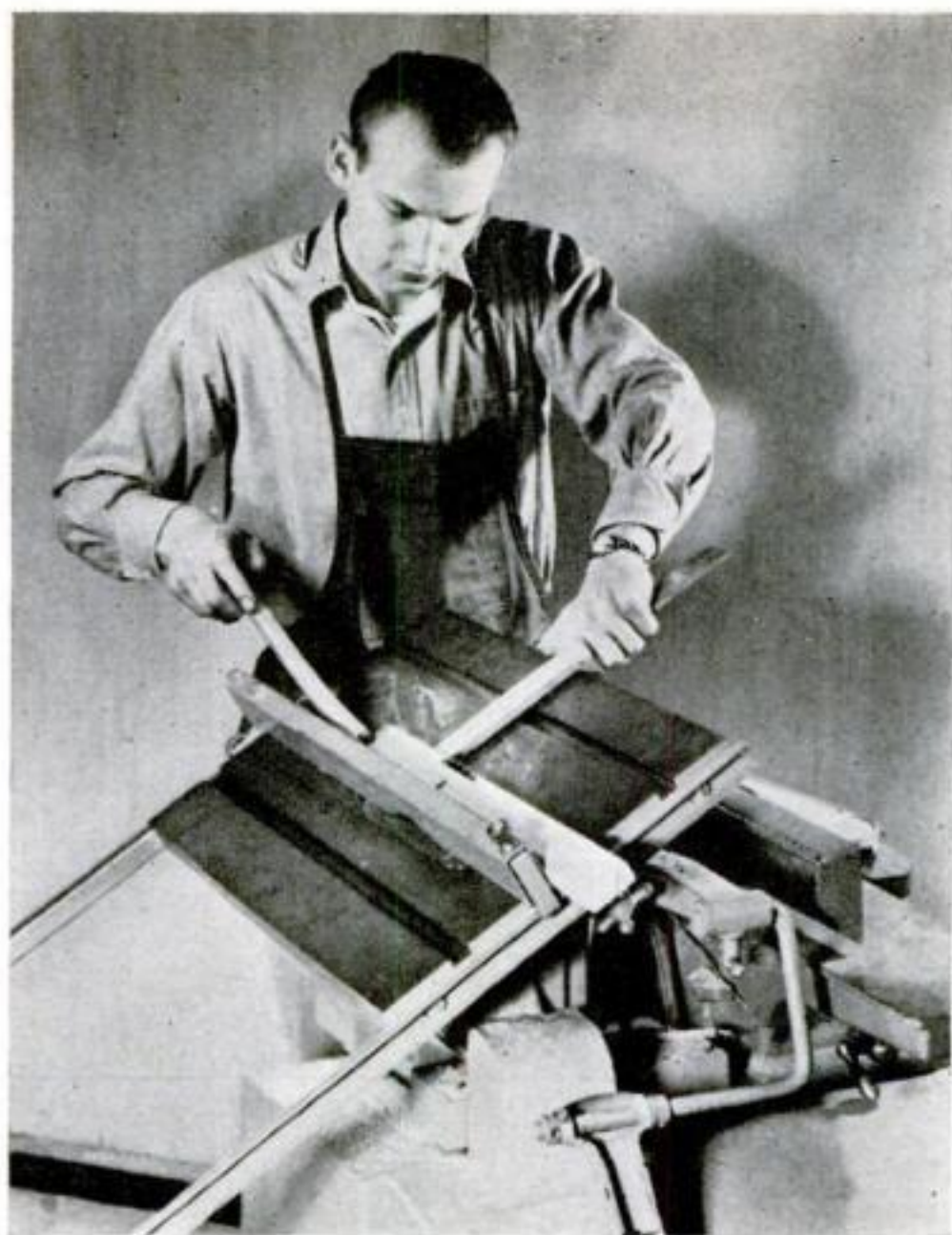
Note: All dimensions are given in inches and are finished sizes.



TURNING DETAIL  
 $\frac{1}{2}$  SQUARES







Robert Jaacks uses two push sticks, one to feed the work, and the other to hold it against the fence, when ripping narrow stock on a bevel. The fence is set below the blade

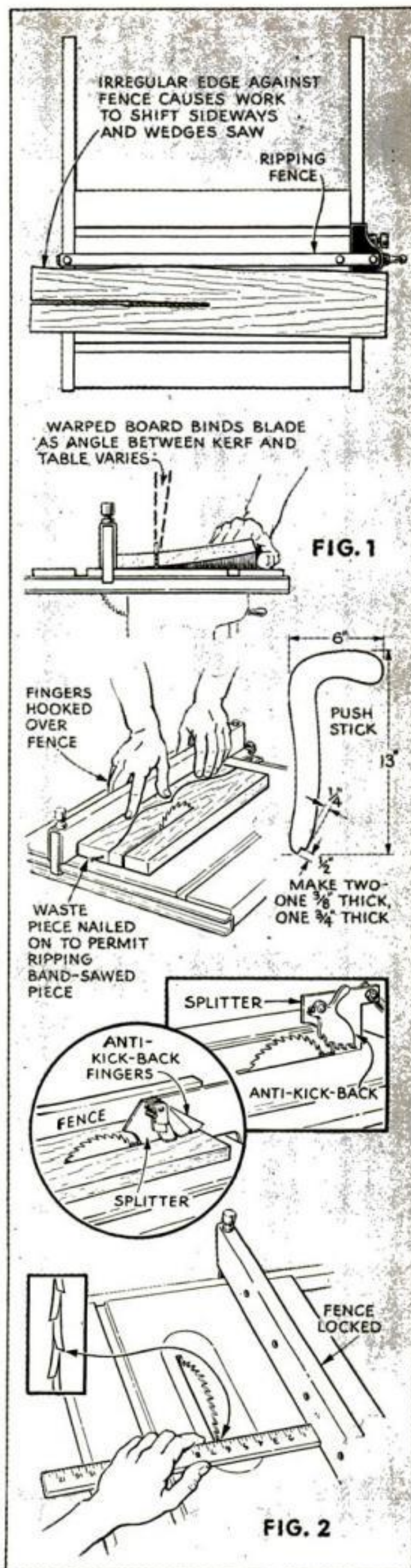
## FIRST STEPS IN USING THE Circular Saw

By EDWIN M. LOVE

HOW to set up and adjust a circular saw was explained in a preceding article (P.S.M., Aug. '41, p. 150). This article deals with fundamental sawing operations. The discussion of advanced practice will be taken up in a later issue.

*How is a board sawed with the grain?*

THIS is called "ripping." Lock the fence at the proper distance from the blade, and feed the board against the saw by sliding it against the fence. Keep the hands out of the path of the blade and the body to the side, so that, if the work is thrown backwards by the saw, it will not strike you. If possible, let the fingers straddle the fence, as in Fig. 1. The edge of the work touching the fence must be straight. An irregular edge will cause the work to shift sideways and pinch the blade. Badly warped boards should not be ripped, as they are sure to bind during the cut. Band-







sawed pieces can be ripped by nailing the waste back temporarily to provide a straight edge against the fence (Fig. 1).

When a board is to be ripped to 3" in width or less, use a push stick. If the machine is not equipped with a splitter, a second push stick should be used to hold the work against the fence, and will be found useful for holding down the far end of the board if it tends to lift from the table. To free a stalled saw, pull the work back, or raise the end of the board nearest you. If this fails, turn off the switch.

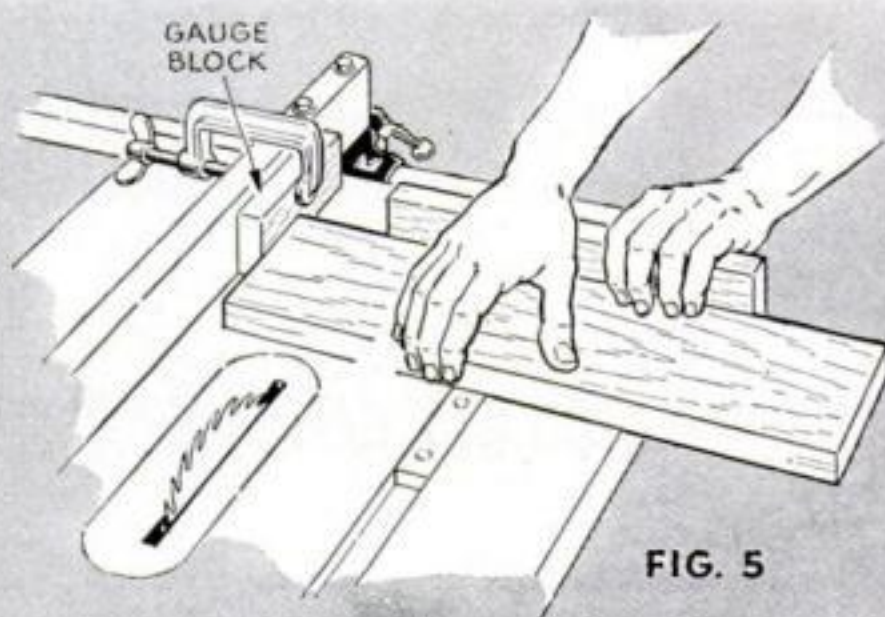
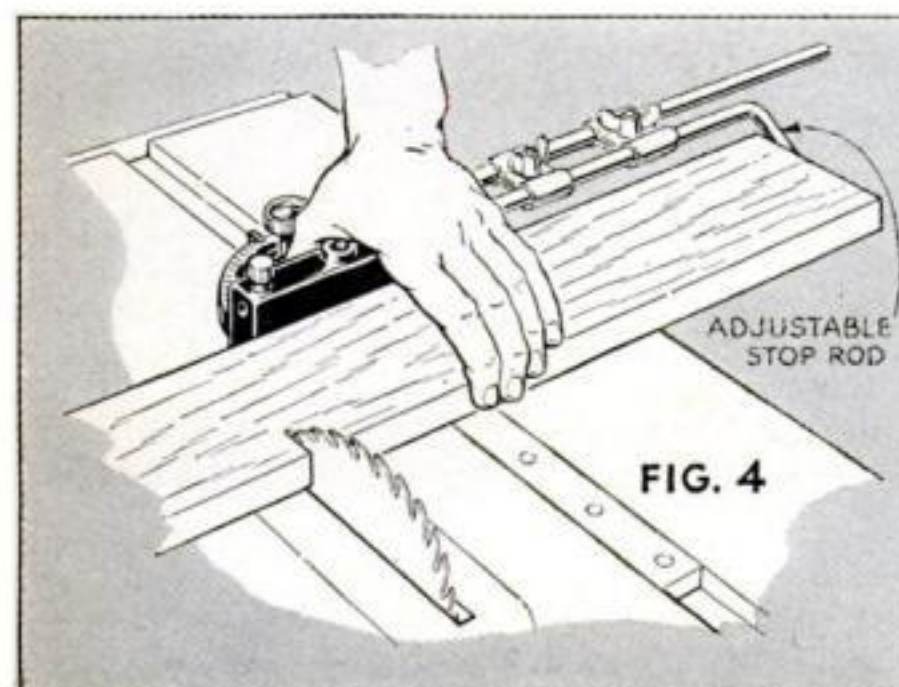
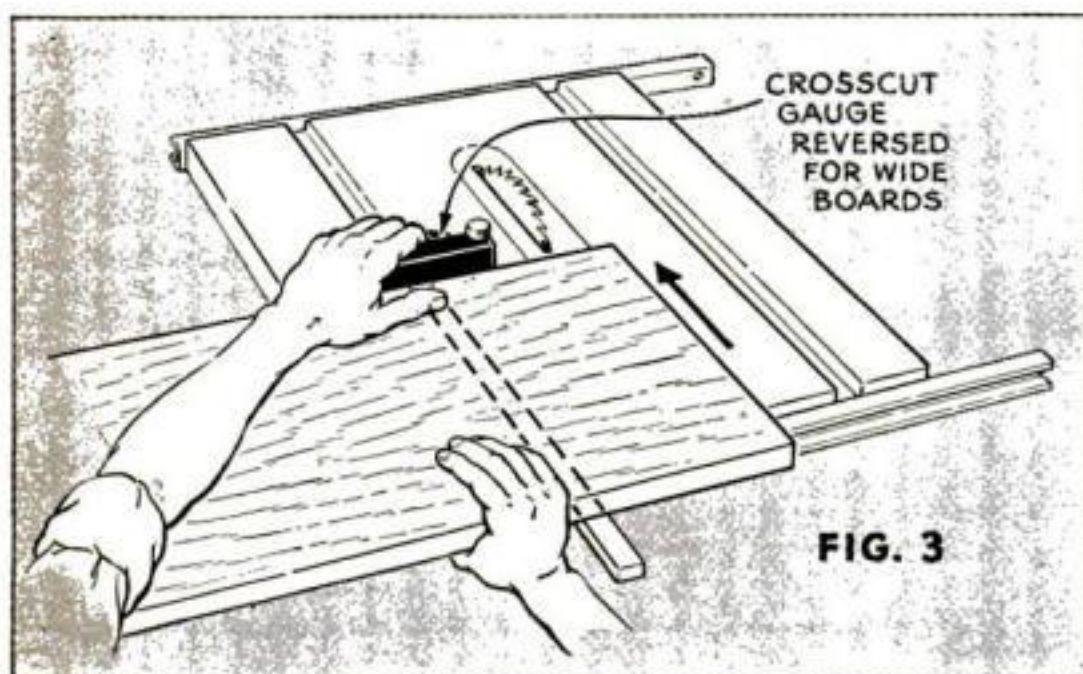
#### *What makes a blade run hot?*

**I**F A splitter is not used, the saw kerf may pinch the blade. To remedy this, push a wooden wedge into the kerf behind the saw. A dull blade, one with insufficient set, or one rough with rust or caked wood dust will also tend to heat. Blades should be kept polished, and may be lubricated occasionally with wax by touching both sides with a candle while in motion.

#### *Is it possible to rip a board that is thicker than the maximum depth of cut the saw will make?*

**Y**ES. Set the blade to cut through half the thickness, and when this has been done, turn the board over lengthwise, starting the cut this time from the other end, and rip again. In the same way, boards up to 4½" wide can be "resawn," that is, boards of this width or less can

The blade guard, for clarity's sake hinged back in the photo and omitted in the drawings, should be used whenever possible





be ripped to a lesser thickness, on an 8" saw.

*How is the fence set for ripping a board to width?*

**A**BOUT 1/16" additional is usually allowed for jointing. Set the fence by the scale, or measure between the fence and a tooth set toward it, as in Fig. 2. Always measure with the fence locked in place, as the very act of locking it may change its position. For utmost accuracy make test cuts on scraps before sawing the work itself. Long boards should be ripped 1/2" wider than the finished width desired, because seasoning strains may cause them to spring into a curve after they have been sawed. Plane one edge straight and rip again, making due allowance for necessary jointing.

*Is bevel ripping done in the same way?*

**Y**ES. The same rules apply. Tilt the arbor, or if the table tilts, adjust it, and set the ripping fence as necessary *on the lower side*. Never put the fence above the blade when the table is tilted, if you can avoid doing so. In crosscutting, do not let stock slip downward and bind the saw.

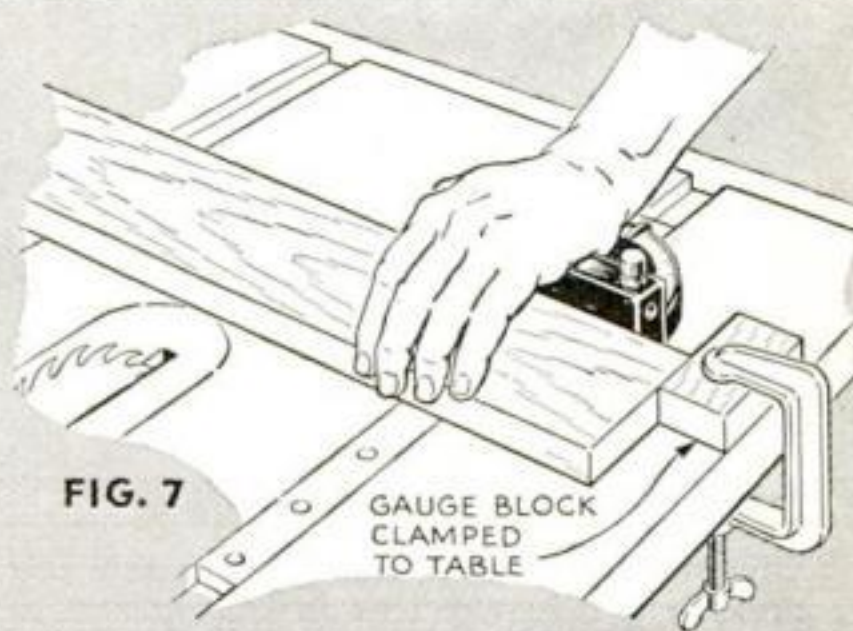
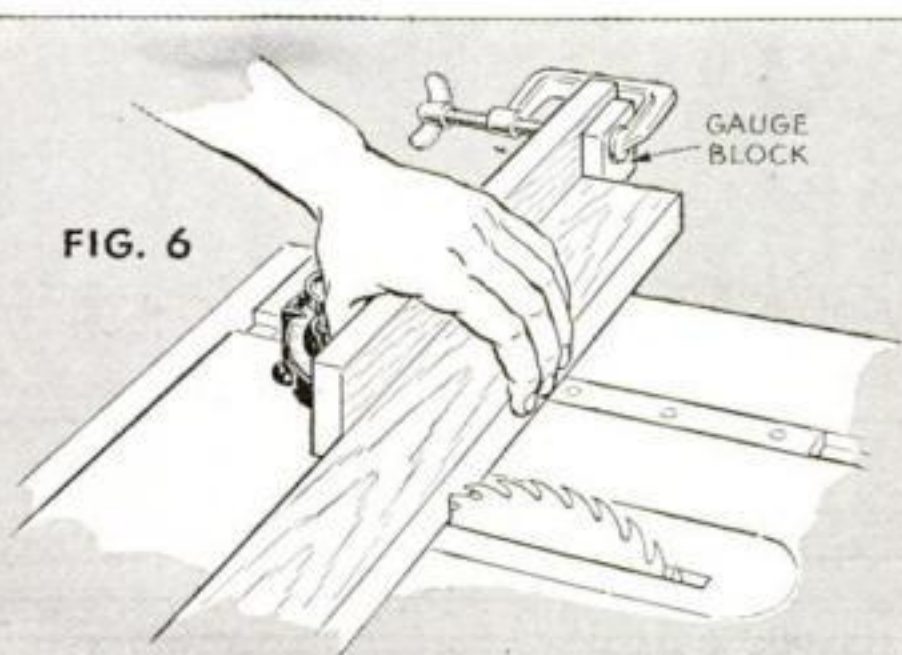
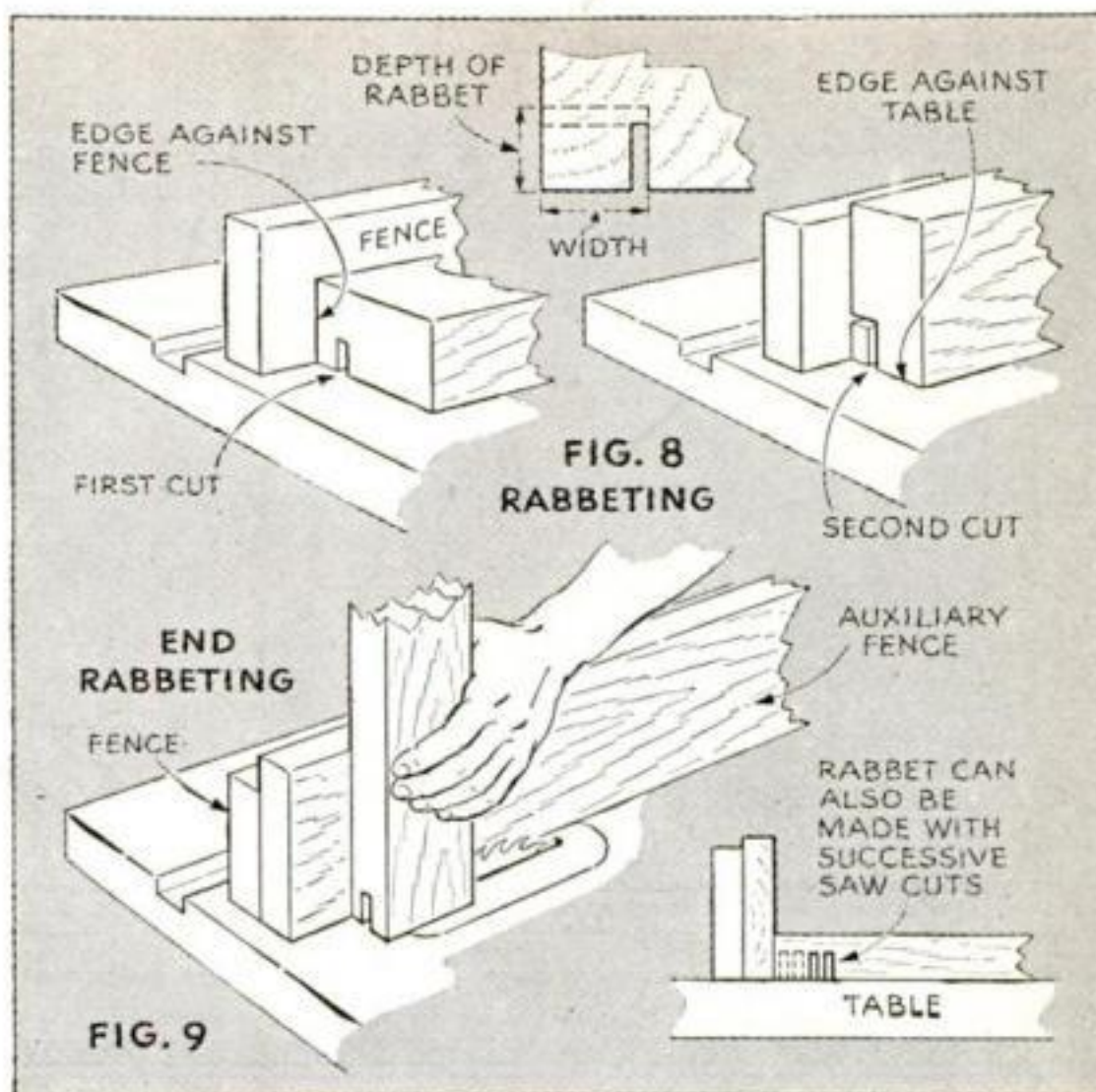
*How is the end of a board sawed square?*

**S**ET the crosscut (miter) gauge square, hold the edge of the board against the head of the gauge, and push both toward the blade, which should, of course, be either the crosscut or combination type. Take care not to shift the work lengthwise. If the

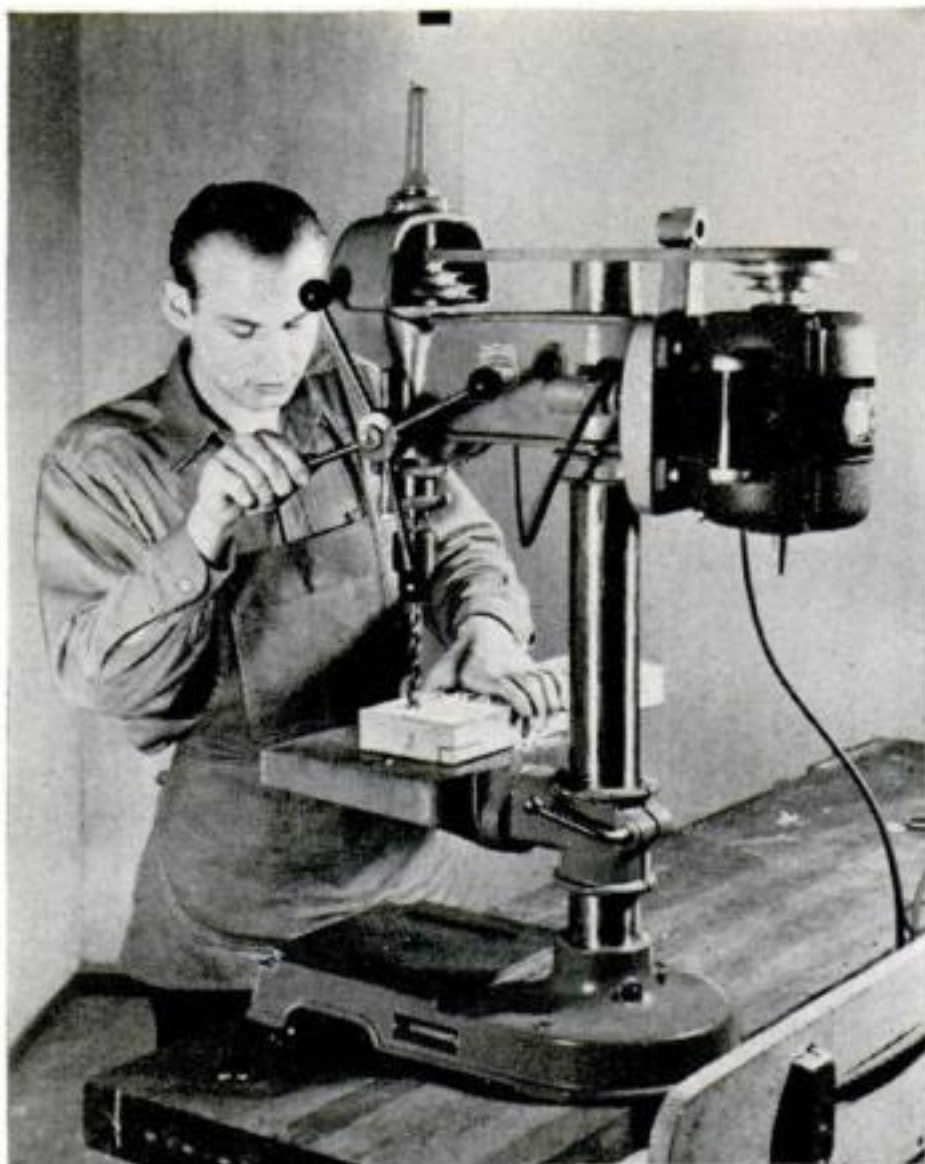
board is so wide that it projects in front of the saw table, reverse the gauge and carry the front edge of the piece with the hand, as in Fig. 3. When cutting long boards get somebody to help you or, better still, use an adjustable rest, plain or fitted with rollers, on which the "outboard" end of the wood can slide as you advance the piece against the blade. Special care is necessary to avoid binding when sawing unwieldy pieces.

*What is necessary to make angle and miter cuts?*

**A**DJUST the gauge head to the angle required and proceed as with a square cut. The saw table or arbor may be set for a bevel cut at the same time, if necessary, as when making hoppers. [Continued]







## Jaacks Adds Drill Press to His Budget Shop

READERS of this series will remember that in the March issue Robert Jaacks reported on the equipment of his budget shop. At that time, there remained unpaid \$12 on his 11" lathe. This has since been paid, and now, in the twenty-second month, he has made a down payment on a bench drill press, to be completely paid for within three months. The machine has a ball-bearing spindle, four speeds, and a  $\frac{1}{2}$ " capacity key chuck. A set of eight machine spur bits from  $\frac{1}{4}$ " to  $\frac{3}{4}$ ", and a set of five router bits from  $\frac{1}{4}$ " to  $\frac{1}{2}$ ", have also been bought, for cash.

Robert Jaack's other machine equipment includes, besides the lathe mentioned, an 8" circular saw, a 4" jointer, a 24" scroll saw, and accessories for these power tools.

### How are pieces cut to length?

**M**ARK the length on the board with a pencil or knife, and use the crosscut gauge as above. For rapid duplication, use metal stop rods clamped in holes in the gauge head, as in Fig. 4, or a block clamped to the ripping fence, as illustrated in Fig. 5. Never use the fence alone, because the pieces cut off may then wedge between the fence and the blade. For cutting long pieces, a board is screwed to the crosscut-gauge head, and a block clamped to this board to butt the work against (Fig. 6). Gauge blocks can also be clamped to the table (Fig. 7).

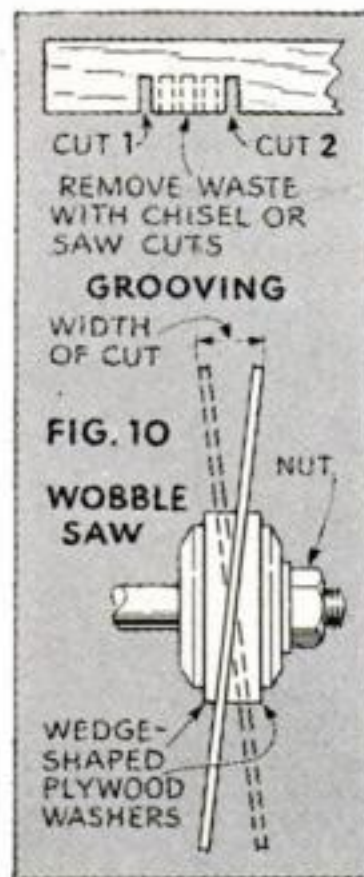
### What is a rabbet and how is it cut?

**A** RABBET is a long steplike recess cut in an edge of the stock, in order, for example, to seat a panel such as the back of a cabinet. Set the saw to cut a little less than the depth of the rabbet, adjust the ripping fence, and run the stock over the blade. Reset the saw to the exact width of the desired rabbet for the second cut, adjust the fence, turn the stock on edge, and run it through again. Be sure that the kerf is in the waste wood, as shown in Fig. 8. On end rabbets (Fig. 9), make the rip cut first, so that there will be stock to bear against the fence. The work should be at least 4" wide

for safety, unless a jig is used, and a board should be screwed to the fence for better support. End rabbets can also be made by crosscutting, instead of ripping (Fig. 9).

### Can grooving be done without special cutters?

**Y**ES. Set the saw as for ripping, with the blade projecting to the depth of the groove desired. Rip one side of the groove, then the other, and remove the waste with additional cuts, or with a chisel (Fig. 10). A "wobble saw," made by fixing the blade at an angle on the arbor, as in Fig. 10, will cut both grooves and rabbets.



### How is plywood cut?

**S**TOCK sheets are square, and can be cut by simple ripping operations. A board screwed to the projecting fence bars affords useful extra table area.





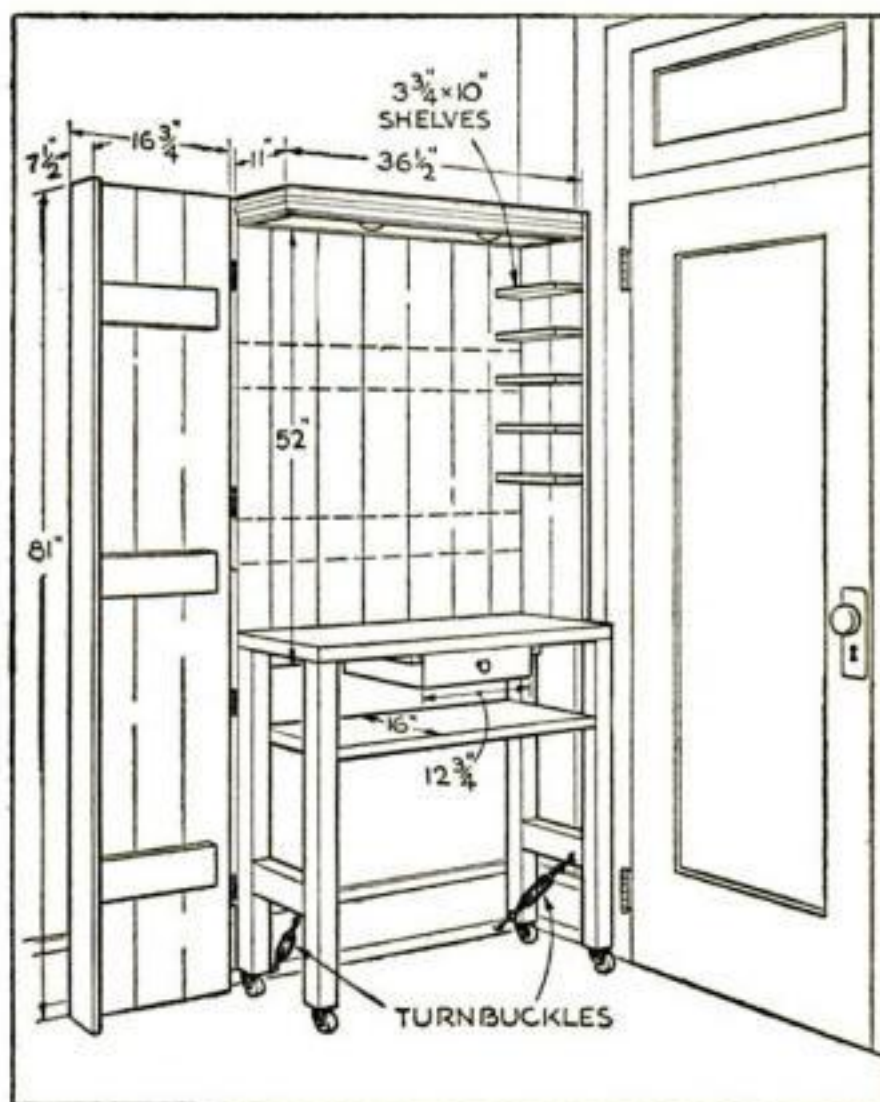
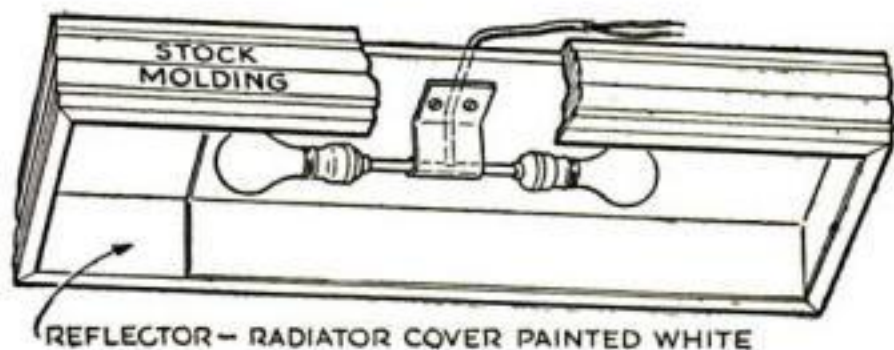
The shop is complete even to a lighting fixture built into the top of the cabinet. To hide the equipment when not in use, the hinged corner is closed and the bedroom door opened

## Midget Workshop Housed in Unused Corner of Apartment

**I**N WASTE space behind the bedroom door of his two-room New York apartment, Daniel J. Rowan, an enthusiastic home craftsman, has built a workshop.

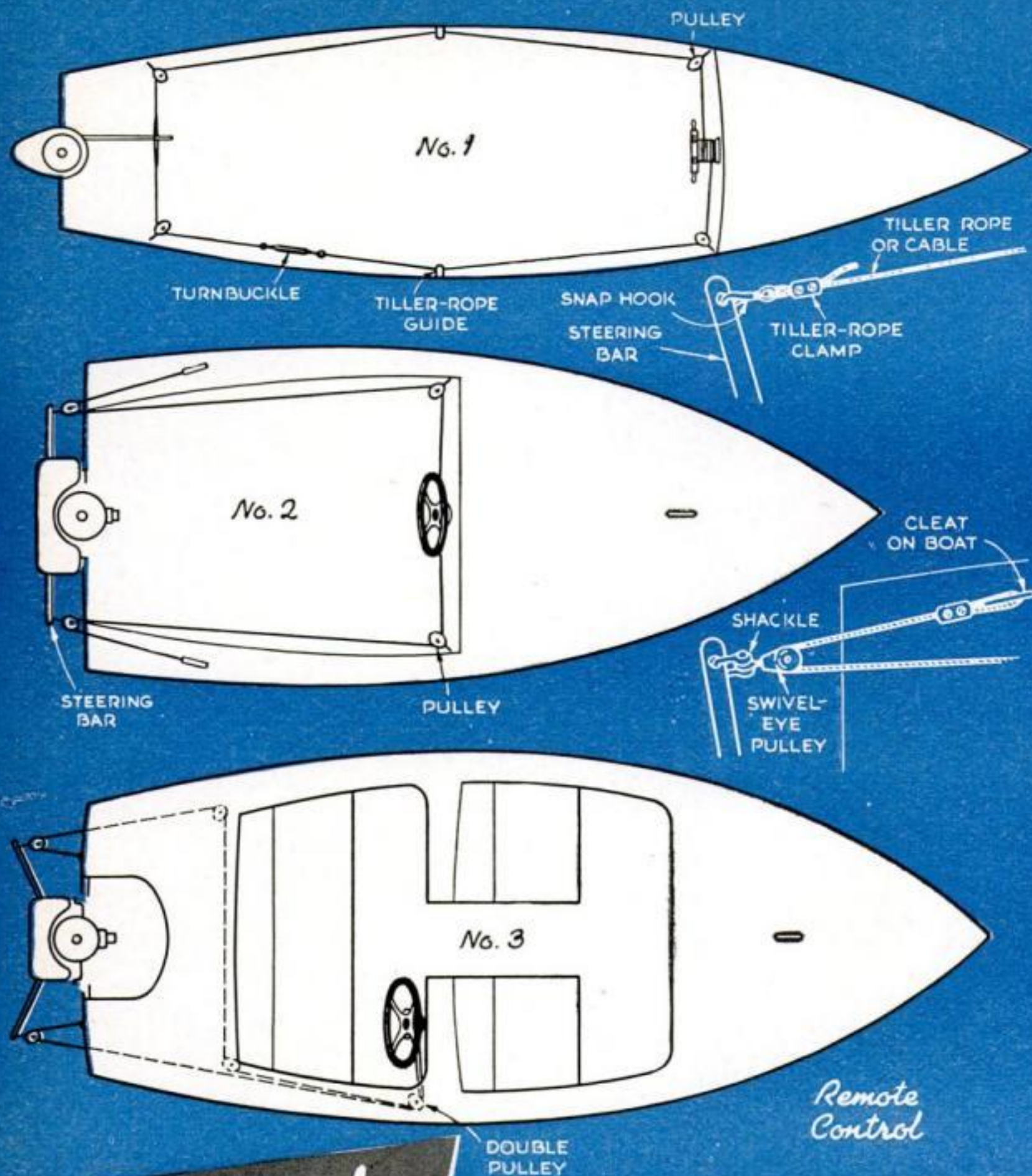
The bench top is a plank 16" by 36". Under it is a drawer for small tools, a shelf for back issues of *POPULAR SCIENCE* and various reference books, and space on the floor where a tool chest is stored. Above the bench is a large tool panel and five small shelves for paints and other supplies. Not the least ingenious feature is an overhead lighting fixture made from an old adjustable metal radiator cover.

The left end of the bench inclosure is hinged as shown, and the bedroom door itself serves to close up the workshop when it is desired to hide bench and tools from view.



How workbench and cabinet are constructed, and, at left, overhead light made from radiator cover



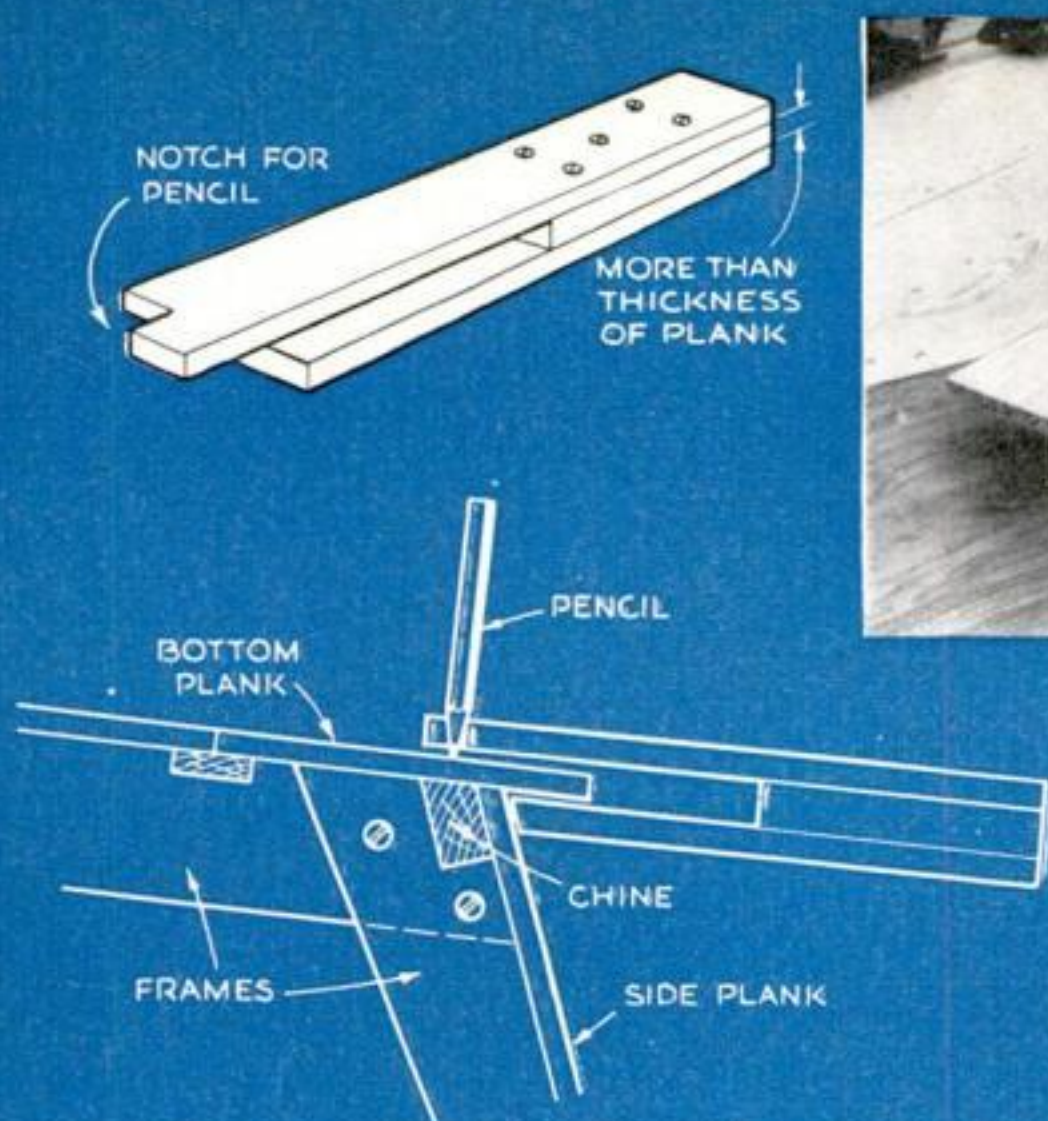


## Boat Hints

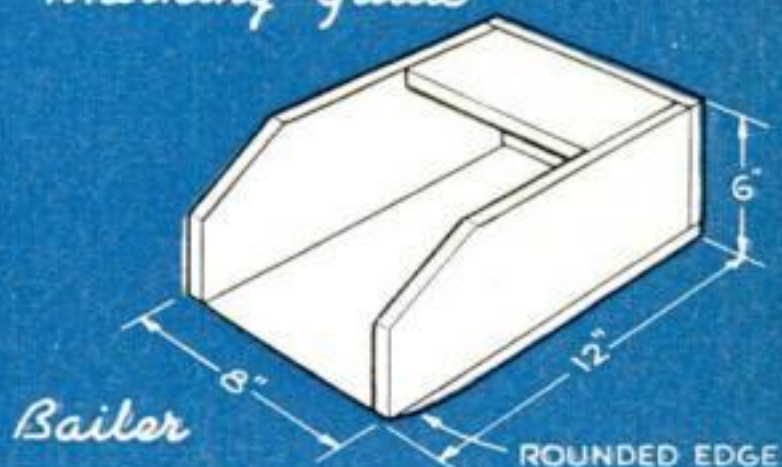
**REMOTE CONTROL STEERING** may be a big help installed in your outboard boat—to trim the boat for best speed and efficiency, to make a fast boat easier to handle, or simply to avoid having to hold the steering bar for long periods. The arrangement in diagram No. 1 is for small motors on rowboats, outboard utility boats, and outboard canoes; diagram No. 2 for racing boats and fast runabouts, and No. 3 when the interior arrangement and steering wheel make it necessary.

Bronze or galvanized tiller cable or tiller rope with a bronze core should be used. Pulleys may be any type, but the diameter of the sheave should be at least  $1\frac{1}{2}$ " for tiller rope or 2" for cable. If the pulleys are not of the swivel type, each must be installed at exactly the right angle. Tiller-rope guides or screw eyes can be used where there is only a slight bend. If the steering bar is long enough, pulleys at this point may be unnecessary, the cable being attached directly to the bar. Tiller-rope clamps and snap hooks are convenient for fastening the cable to the steering bar, are easy to adjust, and in some cases will keep the cable tight without a turnbuckle or strong spring.

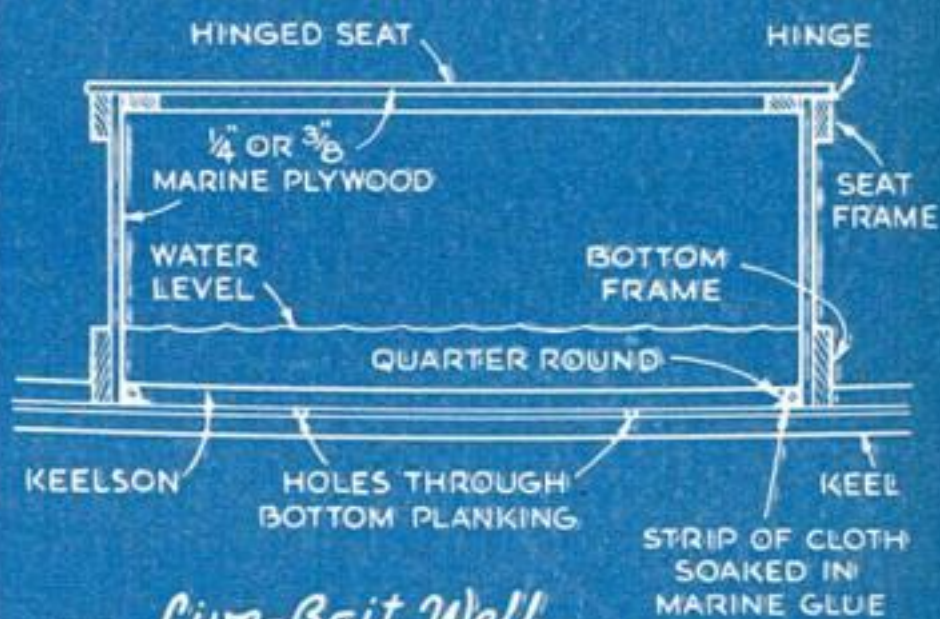
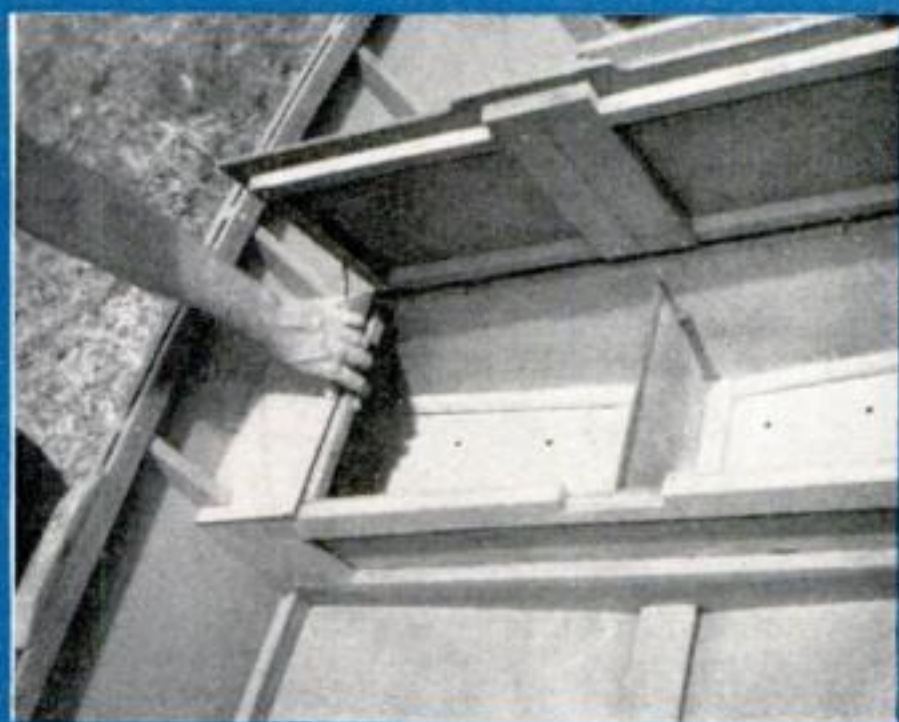




*Marking Guide*



*Bailer*



*Live-Bait Well*

**A GUIDE** for marking the location of a line of screws will insure the accurate placing of screws into chines, sheer battens, stem, and similar parts. It is a handy gadget for the amateur boat builder, and can be made quickly from any scrap material at hand.

**A BILGE BAILER** made in the form of a scoop will be found efficient, especially for bailing out flat-bottom boats. It may be made of waterproof plywood or any wood which will stand water soaking.

**A LIVE BAIT WELL** may be installed in any flat- or V-bottom boat. The best location is usually amidships, where the boat draws the

most water. The one shown is under the rowing seat and is divided into two compartments, one for live bait and one for fish. Bulkheads are first installed, in front and behind the center seat. They should be of marine plywood and are most easily built against the frame of the boat. Plenty of marine glue should be used to make the bulkheads water-tight against the frame, and some quarter-round molding, covering strips of cloth soaked in marine glue, will also be required to prevent any possible leak. After the bulkheads have been tested for leaks, several small holes should be drilled in the bottom to allow water to pass in and out.—WILLARD CRANDALL.





## Peg Pole for Playground Gives Climbing Exercise

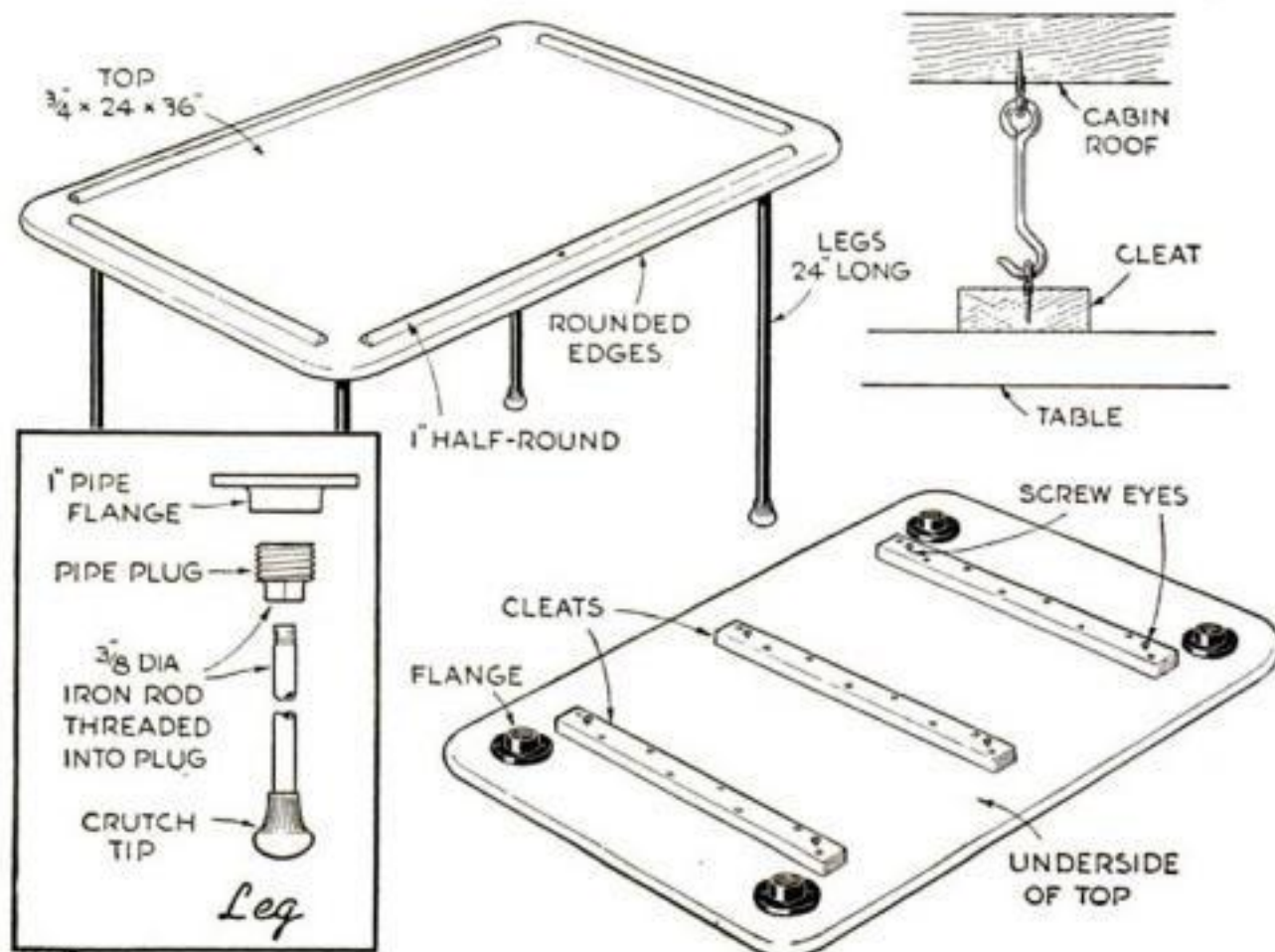
AT A HOME, camp, or school playground, the game of peg pole will challenge the interest of active boys. It is inexpensive and doesn't take up much room, but be sure to allow plenty of space for spectators, because it will prove popular.

Obtain a post from 4" to 6" in diameter and about 10' long. Bore holes of the diameter of an ordinary broomstick 3" deep at varying intervals the entire length of the post, which must be set firmly in cement. Cut three 8" pegs from a broomstick, and sand to fit easily yet firmly in the holes. Be sure to remove all splinters from the post, and if possible give it a coat of good outdoor paint. Allow the cement to set thoroughly before using the pole. It is also a good idea to provide a layer of sand or sawdust a few inches deep around the base.

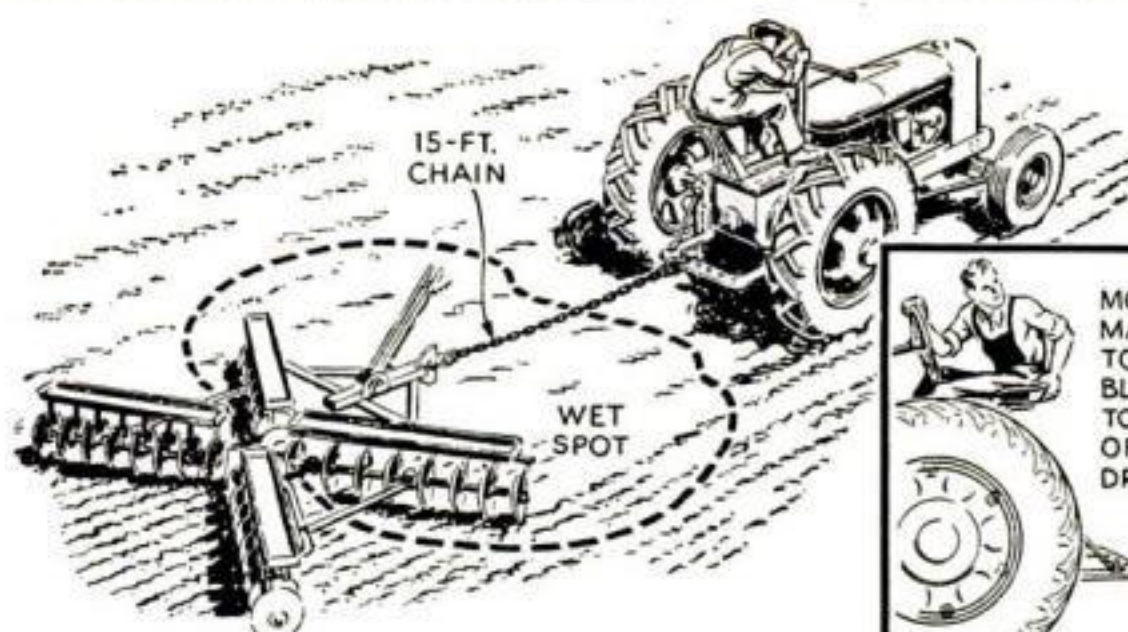
Contestants take turns climbing the pole by removing the lowest peg and placing it in a higher hole as they climb. They descend in the same manner. Competition may be stimulated by climbing against time, by requiring a number of rotations of the pole while climbing, by limiting participants to two pegs, and any of a dozen variations. The game brings into use muscles not extensively used in other activities.—ROGER M. WOODBURY.

## Cabin Table with Detachable Legs Is Easily Stowed Away

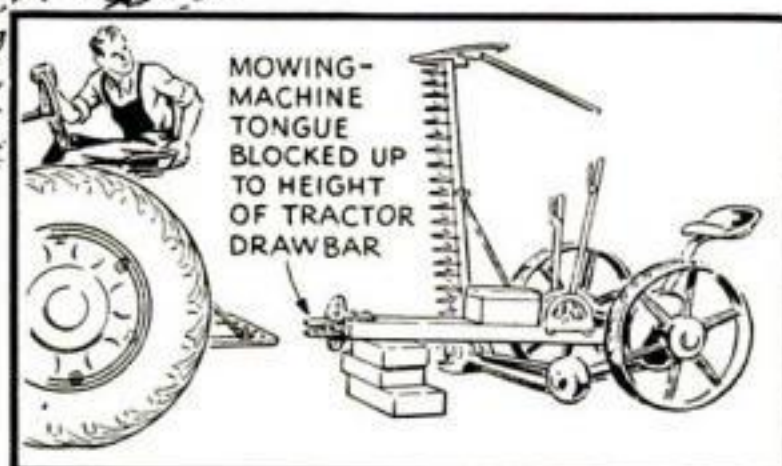
THIS knockdown table will prove serviceable aboard a small boat where space is at a premium. Ordinary  $\frac{1}{8}$ " pipe, which is about  $\frac{3}{8}$ " outside diameter, can be used for the legs instead of rod, if preferred. Rails keep dishes from sliding off, and rubber crutch tips guard against marring the deck. When not in use, the top is hung from the cabin roof as shown, and the legs are held in spring clips fastened to a wall where convenient.—BRUCE MACINTOSH.







A chain enables a tractor to haul from firm ground. Below, blocks facilitate coupling a mowing machine



## Tractor Hints

WHEN USING a tractor and implements to work ground that has soft spots, it is well to carry a heavy chain about 15' long, one end of which is permanently attached to the drawbar. If the tractor stalls in mud, unhitch the implement from the drawbar and connect it instead by means of the chain. Thus relieved of its load, the tractor can often reach hard ground, and haul the implement out by the chain.

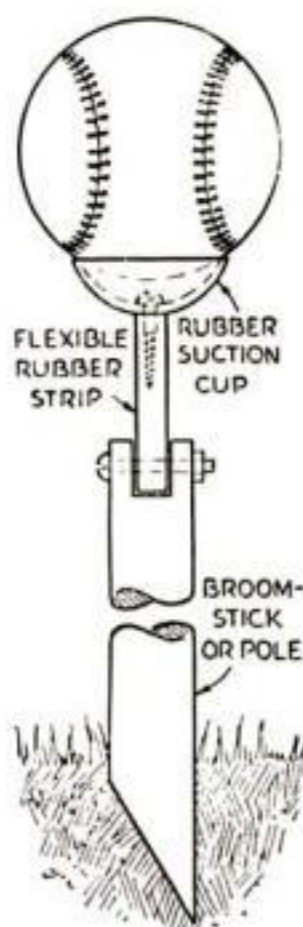
WHERE three men and much effort were previously required to couple a heavy mowing machine to a tractor, one man now does it with ease by the method shown above. Whenever the mower is to be detached, it and the tractor are backed into the garage together, and the mower tongue is blocked up to the height of the tractor drawbar before it is uncoupled. To recouple it, the tractor is backed in, the connection made, and the blocks removed.

## Boys Learn to Bat by Using Novel Homemade Baseball Tee

BOYS who are learning to play baseball can improve their batting with this baseball tee. It also insures better fielding practice for their team mates. The materials: An old broomstick or rake handle, a  $\frac{1}{2}$ " by  $\frac{1}{2}$ " by 2" flexible strip cut from an old tire casing, a rubber suction cup, a  $\frac{1}{8}$ " bolt  $1\frac{1}{2}$ " long with nut, a  $1\frac{1}{2}$ " slender screw, and rubber cement.

Point one end of the pole and notch the other  $\frac{1}{2}$ " deep and  $\frac{1}{2}$ " wide. Drill a  $\frac{1}{8}$ " hole across the notch and through the casing strip; then cement and bolt the latter in the notch. Cement the suction cup fast atop the strip and reinforce with the wood screw.

The pointed end of the tee is stuck into the ground to any depth to suit the batter. For younger boys 3' will be high enough; for older boys, however, 4' will probably be found a more suitable height.





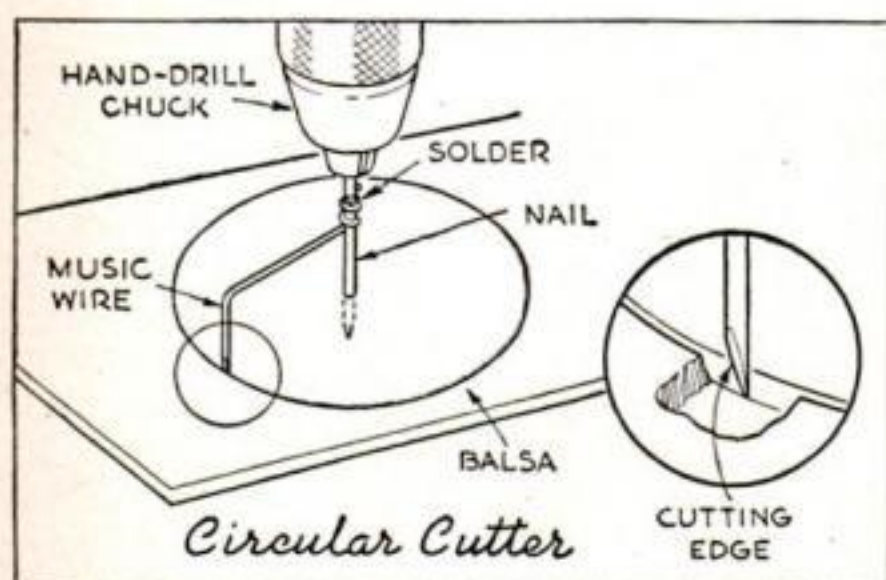


Dick Korda, 1939 Wakefield winner, winding model that set world's record of 43 min., 29 sec. John Zaic, who holds the plane, will testify that this is no job for a flimsy winder

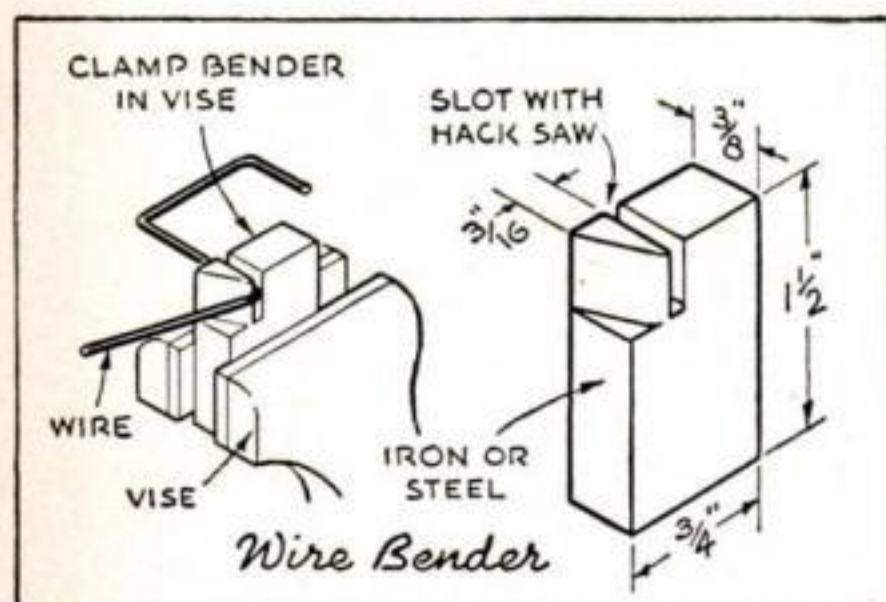
# Model-Airplane Short Cuts

By FRANK ZAIC

Editor of the "Model Aeronautics Year Book"



**CIRCULAR CUTTER.** This tool will be found useful for making balsa wheels or bulk-heads quickly. For cutting thin balsa or wheels 2" or less in diameter, steel music wire 0.040" thick will be satisfactory. If thicker balsa or larger disks are to be cut, thicker wire should be used. Grind the cutting edge sharp as shown, and cut gradually, using a hand drill. Do not force the tool or try to use it in a power drill, as the soldered joint will probably fail if this is done.



**WIRE BENDER.** You can make this jig from a scrap piece of mild steel or even cast iron. The latter is not difficult to work if the surface is not too heavily covered with hard scale, which can often be removed by grinding. With a hack saw and a file, shape the jig as shown. The slot should be slightly oversize for easy removal of the bent wire, but the dimensions given need not be followed exactly. This simple jig is especially useful for shaping thick music wire when making parts for gas models.

**ADJUSTABLE CIRCLE CUTTER.** The dimensions indicated are for a heavy-duty tool that may be used at slow speed in a power drill press.

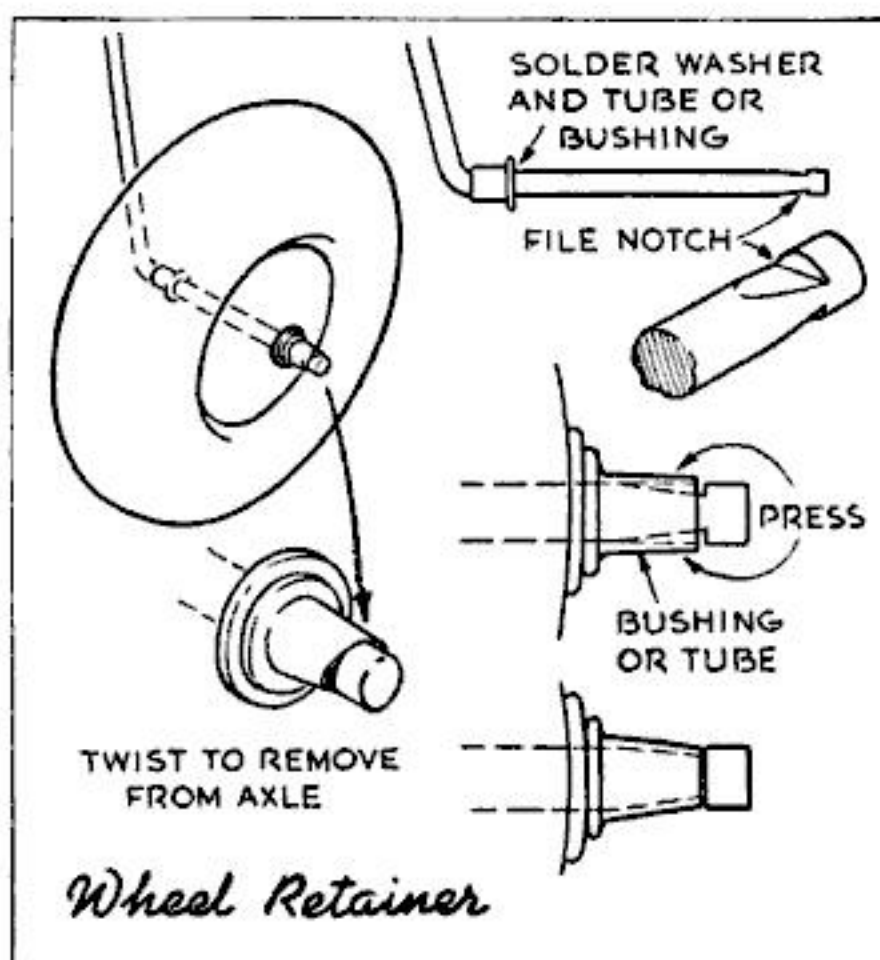
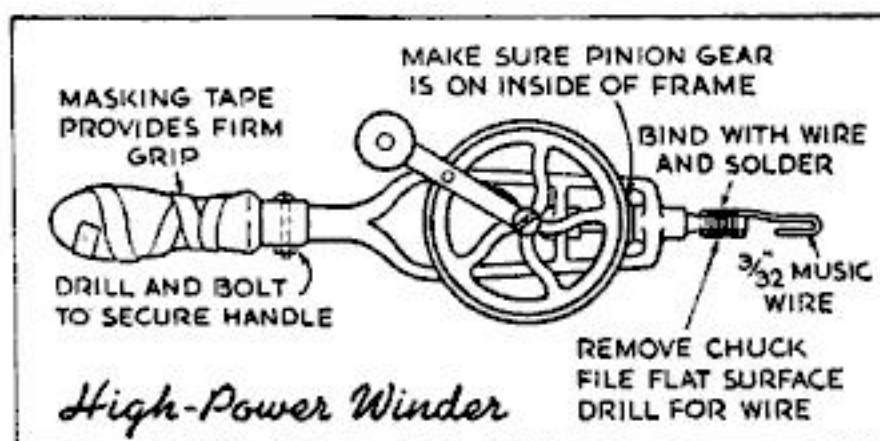
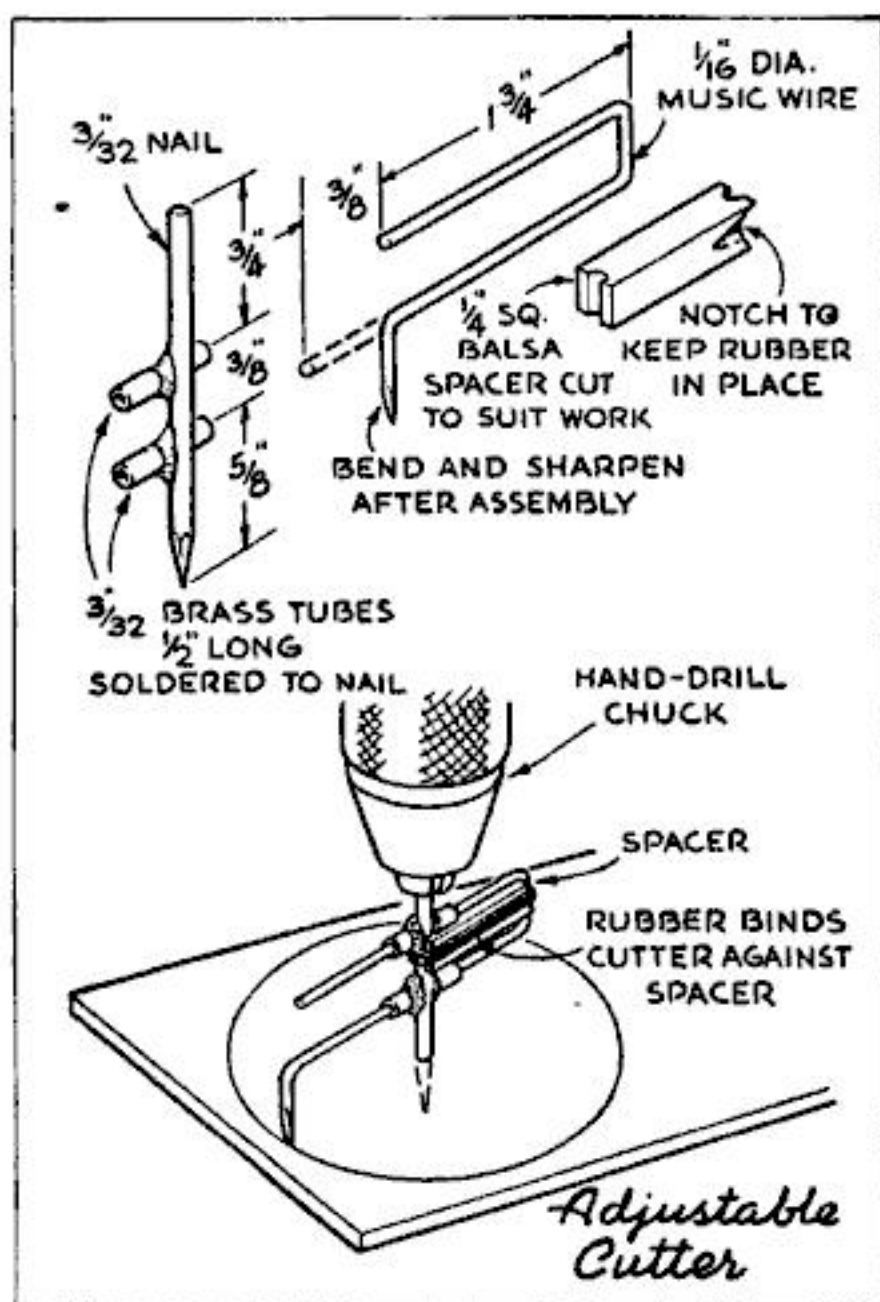
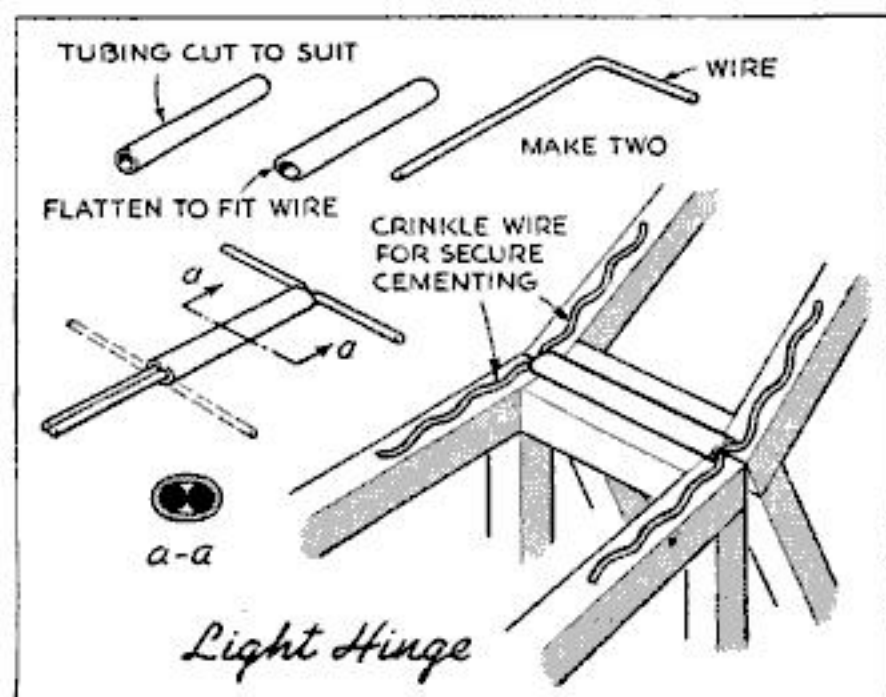


If the feed is gradual, the soldered joints will withstand the strain. A jig made of small nails will hold the parts in their relative positions for soldering. Use balsa spacers and a strong rubber band to hold the cutter arm at various radii.

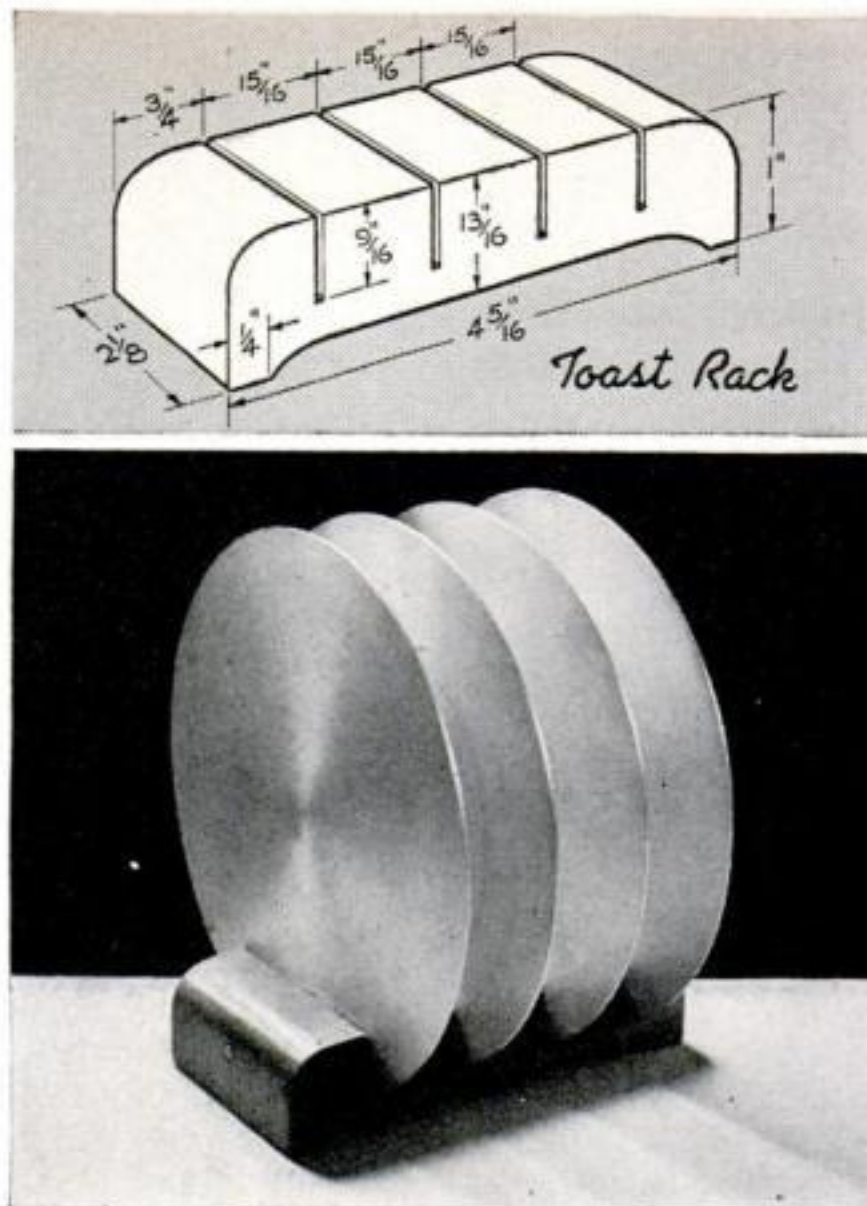
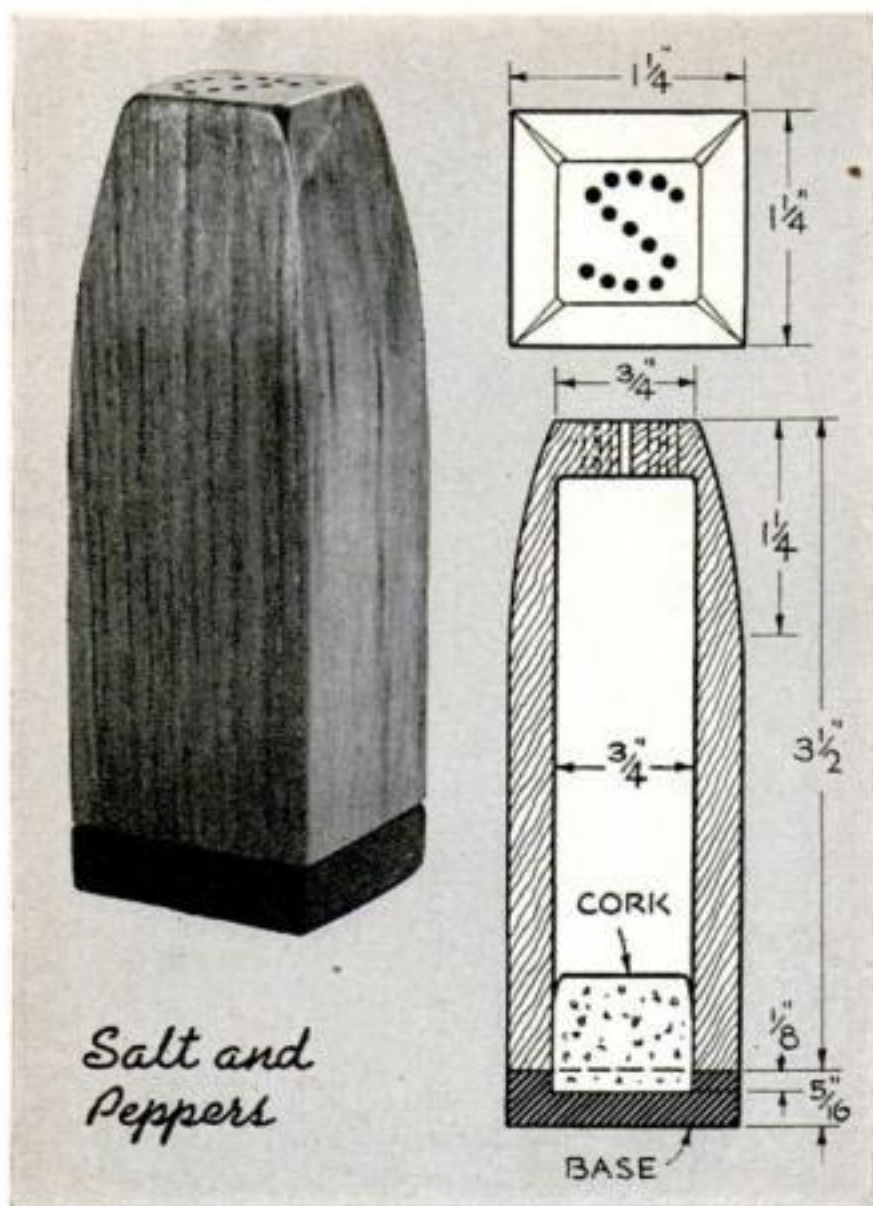
**HIGH-POWER WINDER.** At the moment there seem to be no available winders that will safely handle the high-power rubber motors now in use. The winder shown, however, can be made easily from a suitable high-grade hand drill. Although such drills cost about \$1.50, the investment pays dividends in security. It is dangerous to use winders consisting of a hook clamped in a hand-drill chuck. See that the hook runs true on the shaft and that the handle is securely bolted to the drill frame.

**WHEEL RETAINER.** Music wire, from which landing-gear axles are usually made, is difficult to solder or to thread for a retaining nut. The method shown holds the wheels of even big gas models securely, yet permits them to be removed at any time. Use small eyelets, thin-walled bushings, or short pieces of tubing as shown. This idea was originated by J. P. Glass, a New York model maker.

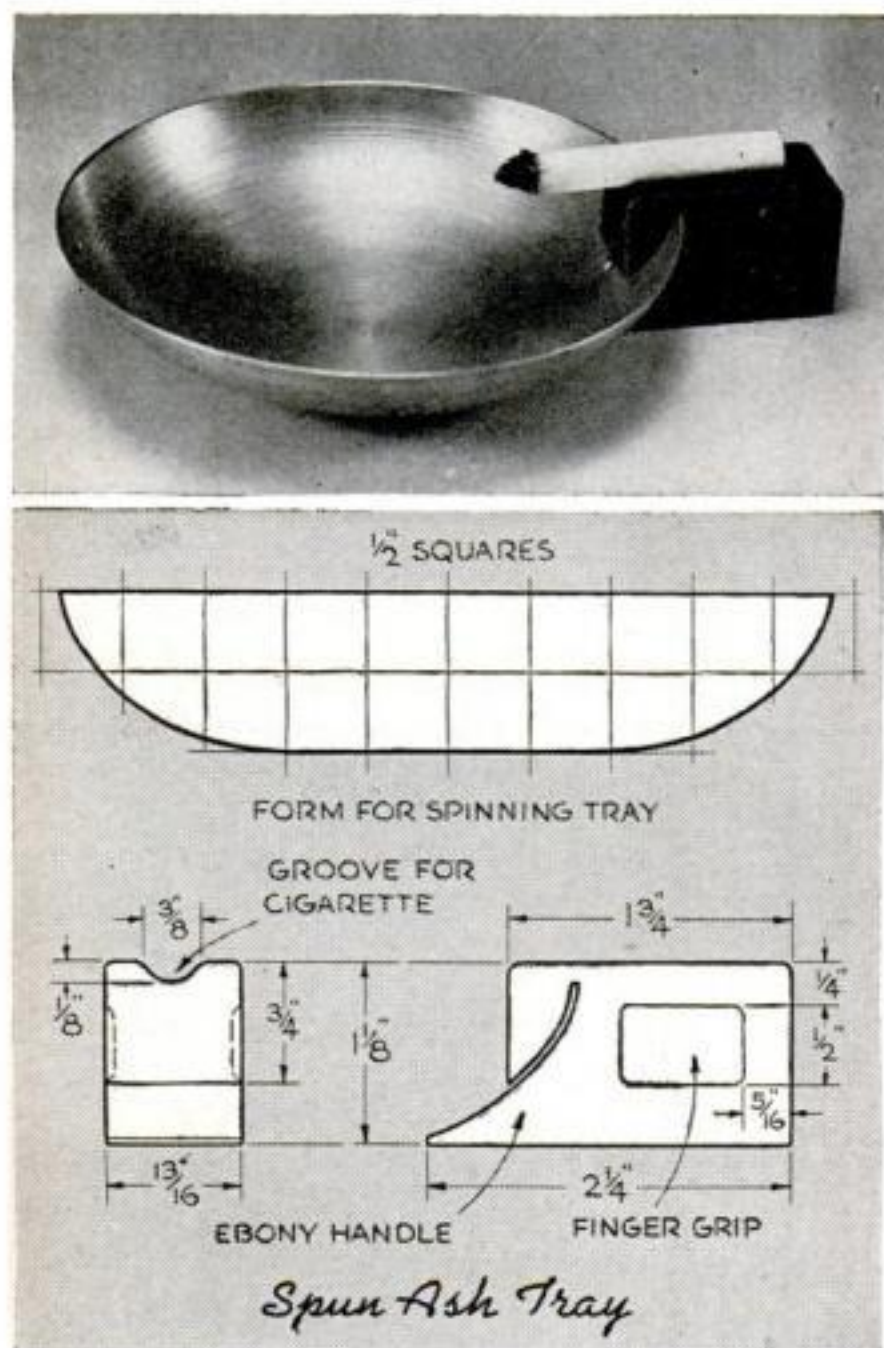
**LIGHT HINGE.** There are a number of places, especially on large planes, where a light, strong hinge can be used to advantage. Here one is shown joining the tail end of a fuselage that is hinged to allow access to the rubber motor. It is best to use aluminum tubing for light models, and brass tubing for heavier duty. If the wire is carefully selected and of the right size, there need be little looseness in the completed hinge. Cut the tubing to correct length, flatten it carefully, and insert the wire pins as shown. The stem ends of the latter are kinked slightly, and the cemented joint should be firmly bound with thread.







## WORKING TIME: ONE EVENING



### Design Projects by Ernest R. Dewalt

WHEN you have just finished a long piece of work and are in no mood to tackle a similar one immediately, making one of these attractive articles will not only provide relaxation and a change of pace, but will enable you to show a finished piece for your evening's efforts. Two designs combine woodworking and metal craft.

**SALT AND PEPPERS.** Use 1 1/4" square stock, teakwood, walnut, maple, or the like, for the bodies, which can be shaped on a machine sander quickly. Centerdrill with a 3/4" bit, then drill holes into the tops to form the initials "S" and "P," using a slightly smaller drill for the latter.

The base pieces may be ebony, black phenol-formaldehyde composition, or plastic. Centerdrill them to a depth of 1/8" and glue in slightly tapered cork stoppers. Sand bodies and bases together. Apply several coats of shellac, and wax well. Approximate time, 2 1/2 hours.

**TOAST RACK.** Smart for the modern breakfast table, this accessory can be made with a base of dark or light wood and uprights of any suitable metal on hand. Walnut and aluminum were used for the rack



illustrated. Undercut the base on a band saw, slot for the uprights, and round the ends on top.

The metal disks can be cut and burnished by hand, but are more quickly made by mounting 5¼" squares on a wooden face-plate in the lathe. Hold a wire brush against the surface while in motion, then remount the metal with the other side out, and after brushing this side, cut out the disk with a cutting-off tool or the sharpened end of a file. If the disks are obtained already cut, they can be mounted in a shallow turned depression on a wood disk for wire brushing in the lathe.

Cut a segment from the bottom of each disk, drill a ⅛" hole through disks and base, and assemble with a single tight-fitting pin after finishing the base with shellac and wax. Approximate time, 3 hours.

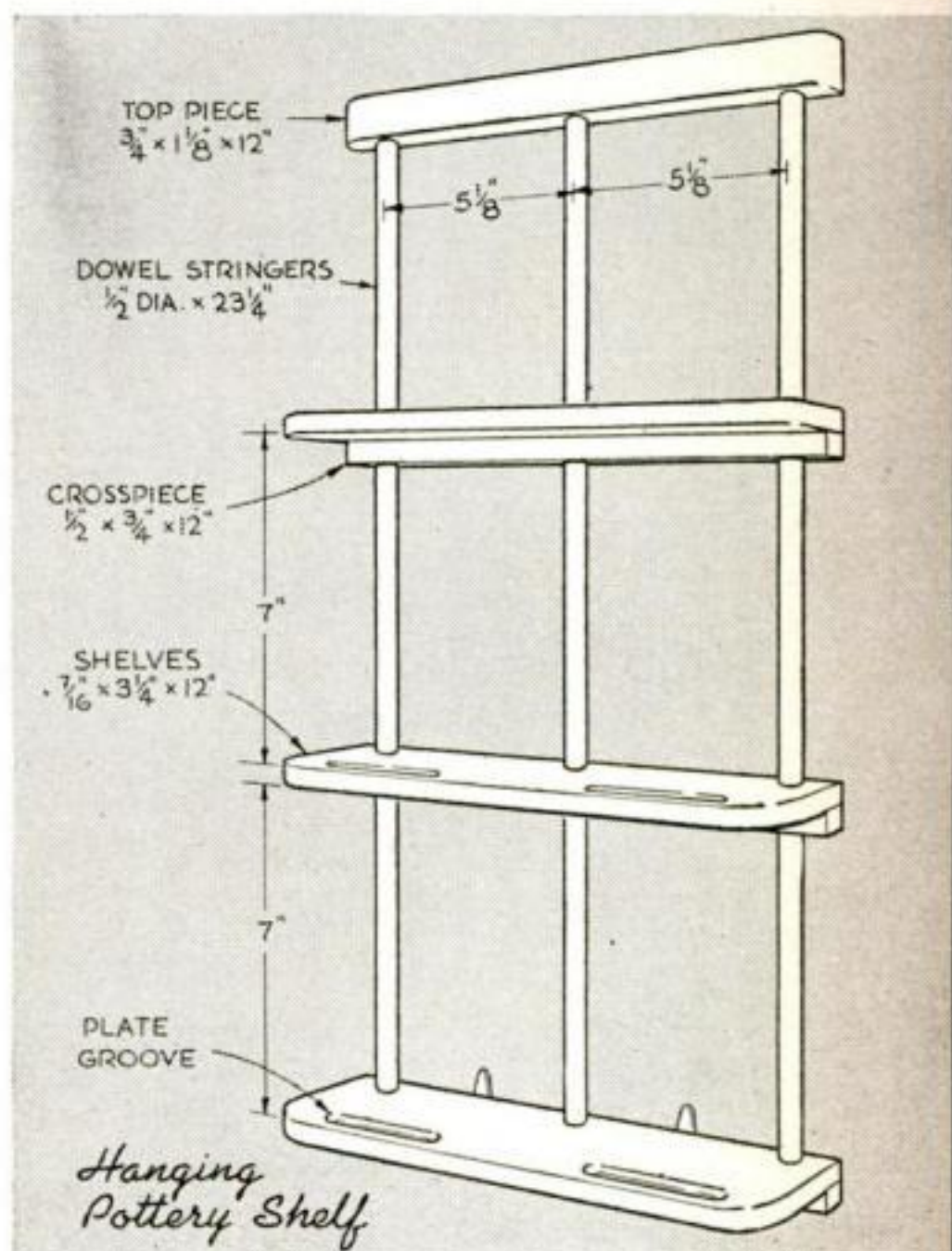
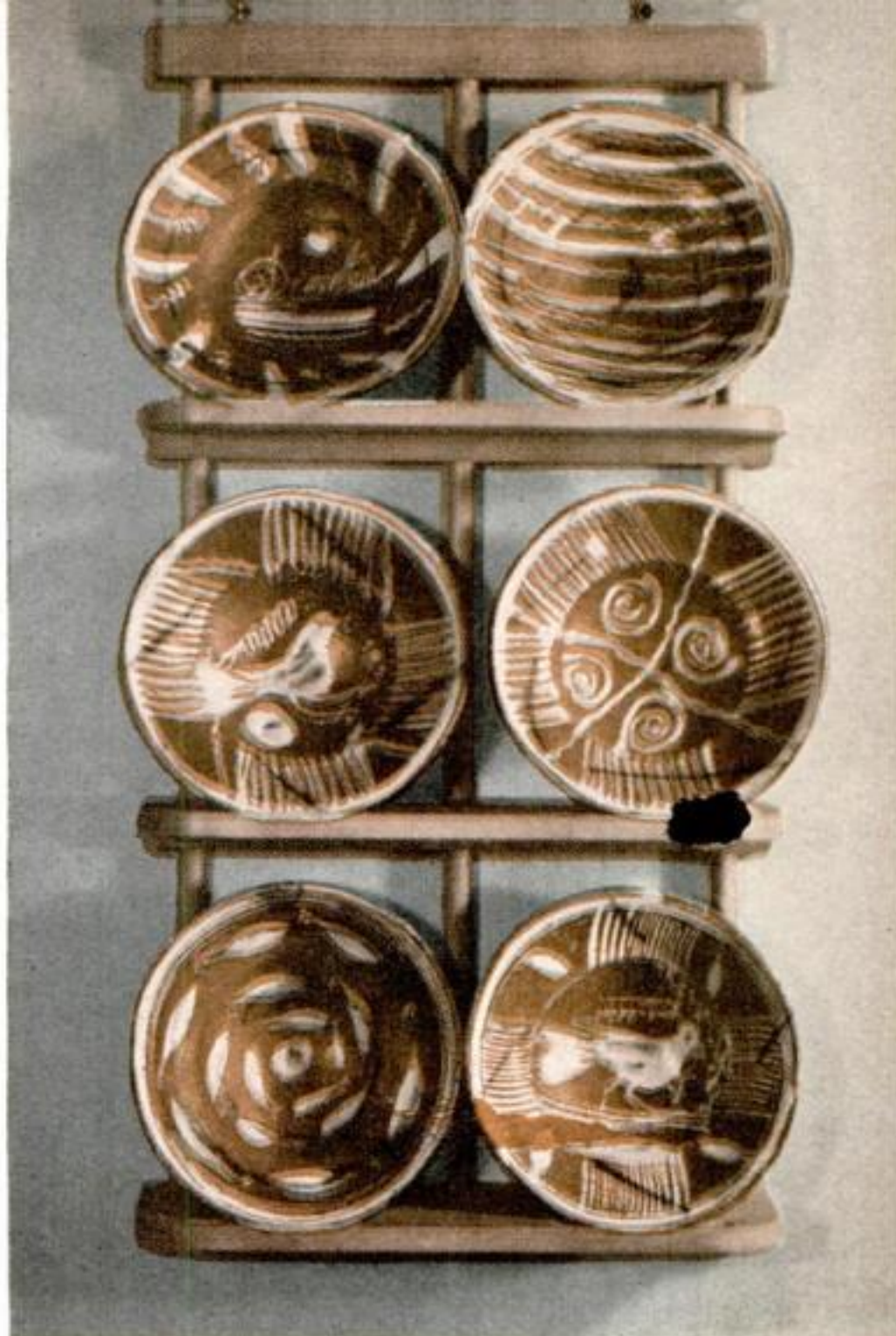
**SPUN ASH TRAY.** If neither copper nor aluminum is available, this can be spun from ordinary tin-can metal (see page 180). A template may be made from the drawing for turning the necessary hardwood form. The spun bowl may be lacquered or enameled, or, if a suitable metal is used, buffed to a high polish.

The handle and cigarette rest was made of ebony. File the groove for the cigarette on top, and carefully gouge out the concave finger grips on the sides. Band-saw the curve to fit this piece to the tray. Finish the wood with shellac or clear lacquer, rub down, and attach it with a single escutcheon pin. Approximate time, 3 hours.

**HANGING POTTERY SHELF.** This can be custom-built to fit plates or bowls of odd size, for the type of construction enables the dimensions to be modified. The depth and position of the grooves can be altered, but plates should lean at an angle of not less than 15 deg.

Clamp all the shelves together to drill for the dowel stringers. If an odd number of stringers is used, center the middle one. Use a drilled shelf as a jig to locate the holes in the crosspieces and the toppiece. The grooves are best made with a ¼" router bit, and the work guided by a fence on the drill-press table. Glue and brad the crosspieces to the shelves, round the corners of the latter and of the toppiece, sand all parts smooth, and assemble. Drive a single nail from the back where the dowels pass through.

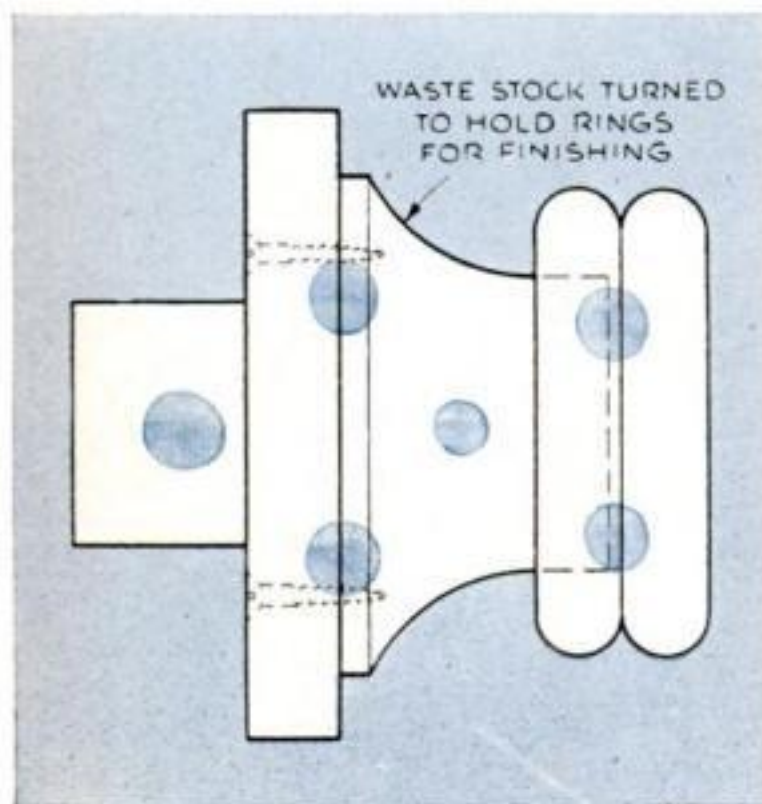
An attractive color finish is obtained with a stain consisting of white paint tinted with vermilion, rubbed into the pores but wiped off the surface. Let this dry, then wax and polish. Attach metal hangers or eyelets for mounting. Approximate time, 3½ hours.







Rings have turned grooves and tenons. Glue together so that one grain crosses the other



When the glue has set, mount the rings on a mandrel turned from waste stock. Apply a shellac finish while they revolve in the lathe

## TURNED TRAY OF MODERN DESIGN

**M**ODERN simplicity of design gives distinction to this attractive walnut tray.

First, cut a  $10\frac{1}{2}$ " disk from  $\frac{3}{4}$ " walnut, glue it to a piece of waste stock, mount on the lathe faceplate, and hollow out the front to a center depth of  $\frac{5}{8}$ ". Turn it down from the back also, so as to leave the edge  $\frac{1}{4}$ " thick. Before removing the disk, sand it thoroughly, apply paste filler, wipe off the surplus, and apply a coat of shellac. On a clean cloth place a little shellac and a few drops of oil and alcohol. Start the lathe and hold the cloth against the disk before the shellac dries. This gives a high gloss finish. When the surface has been finished, use a parting tool to remove the waste stock, and finish the center section of the underside by hand.

For the legs, turn three rings from maple to an outside diameter of 2" and a thickness of  $\frac{3}{8}$ ". Turn a groove  $\frac{1}{16}$ " deep and  $\frac{1}{16}$ " wide in one side of each ring. Then turn three more rings of the same dimensions, but on one side of each leave a projecting ridge or circular tenon, as shown, which fits exactly into the groove in other rings.

Glue the matching rings together in pairs, placing them so the grain in one ring is opposite to the grain in the other. They will then reinforce each other.

To finish these rings in the lathe, mount a piece of waste stock on the faceplate and turn it so that the rings fit snugly over it, as sketched. It should be short enough to leave the inside of the outer ring accessible. Apply the finish to this inner part

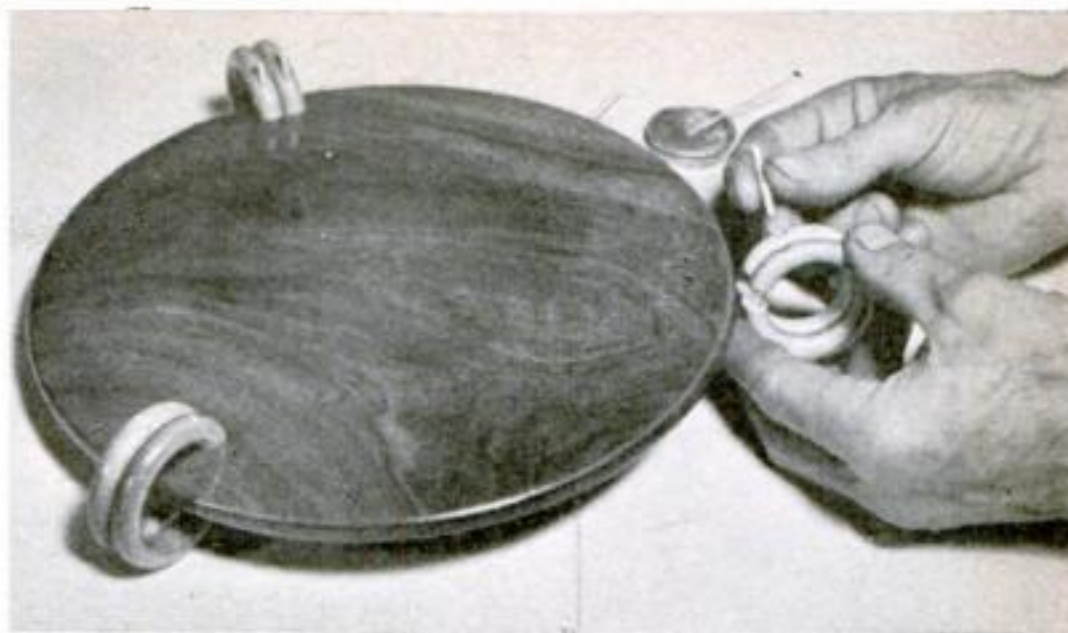


Average Time  
6 hours

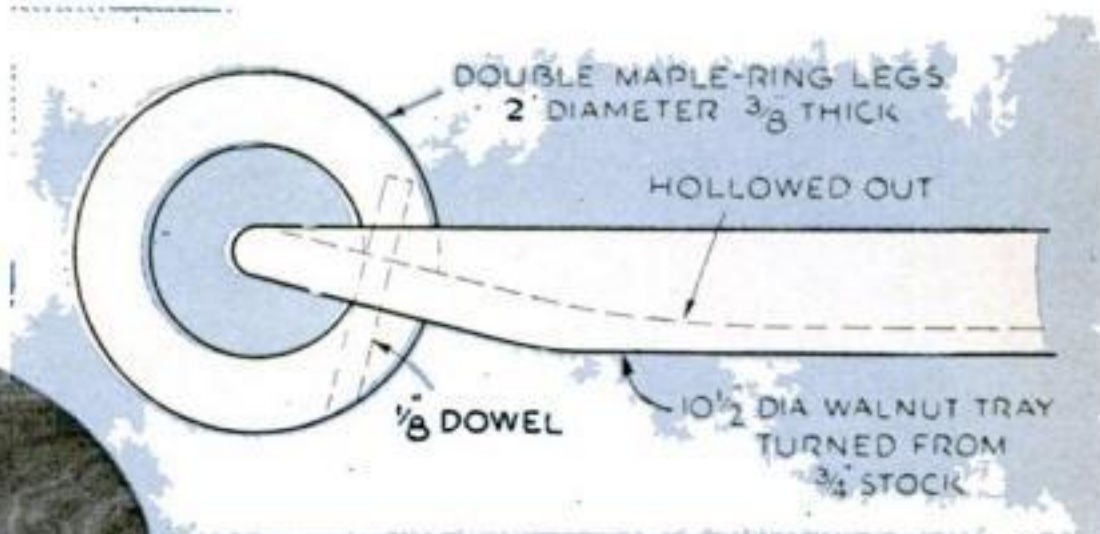


and to the outside in the same manner as on the tray. Wait a few minutes for the shellac to dry, then reverse the ring and finish the remaining part.

Saw out a piece in each pair of rings so they may be slipped over the edge of the tray as shown. Using a cloth to protect the finish, place the rings in the vise and drill two  $\frac{1}{8}$ " holes in each pair for the dowels as indicated, being careful not to pierce what will be the upper side. Slip the rings over the edge, spacing them equally. Set the inner ends 1" in from the edge. Place the drill point in the holes in the underside of the rings and drill through the walnut plate. Glue  $\frac{1}{8}$ " dowels in place.—BENJAMIN NIELSEN.



The glued-up rings are slotted to fit snugly over the edge of the turned plate, and attached by means of two glued dowel pins



Turn the extreme edge of the plate a trifle thinner than the part over which the legs fit. Drill dowel holes through rings and plate as shown above

Charming in its modern simplicity, the design may be altered to make a cake server by leaving the plate flat on top and turning only the beveled lower edge. Slot the legs to fit

## SILHOUETTES

[METAL ETCHING—8]

In etching cut-outs, letters, and silhouettes in copper and brass, use thin metal and clean it with a dry abrasive. Paint all parts that are to be left untouched by the acid with an even coat of asphaltum, including the back and the edges. In designs that are to be etched out to form a picture, a section of each part should join some other part so that none will fall out of the plate. Any irregular lines may be straightened by scraping away the asphaltum after it is thoroughly dry.

A slow process of etching is advisable in this case, as in all etching where more than 0.002" or 0.003" depth is required. A bath composed of one part water to which one part commercial nitric acid is cautiously added will give satisfactory results. After the asphaltum backing is dry and hard, submerge the plate in the bath for etching. Watch closely, and remove promptly when the acid has eaten through the metal.

Another method is to coat the entire surface of the metal on both sides with asphaltum and let dry hard. Outline the letters or subject with a soft lead pencil; then use a scribe or scratch awl to mark only the outline through the coating. In this case the acid will attack only where the metal is exposed. If good, sharp lines have been scratched through the coating, the surplus metal will drop away when the acid has eaten through.

Remove the asphaltum with kerosene or lacquer thinner, and finish as desired.

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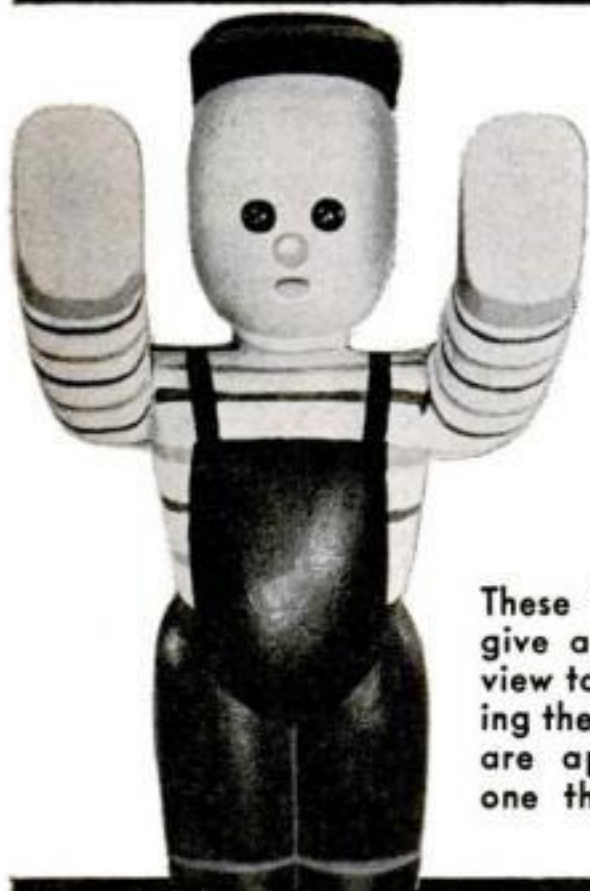
# STURDY STEVE

BRACES HEAVY-DUTY BOOK ENDS

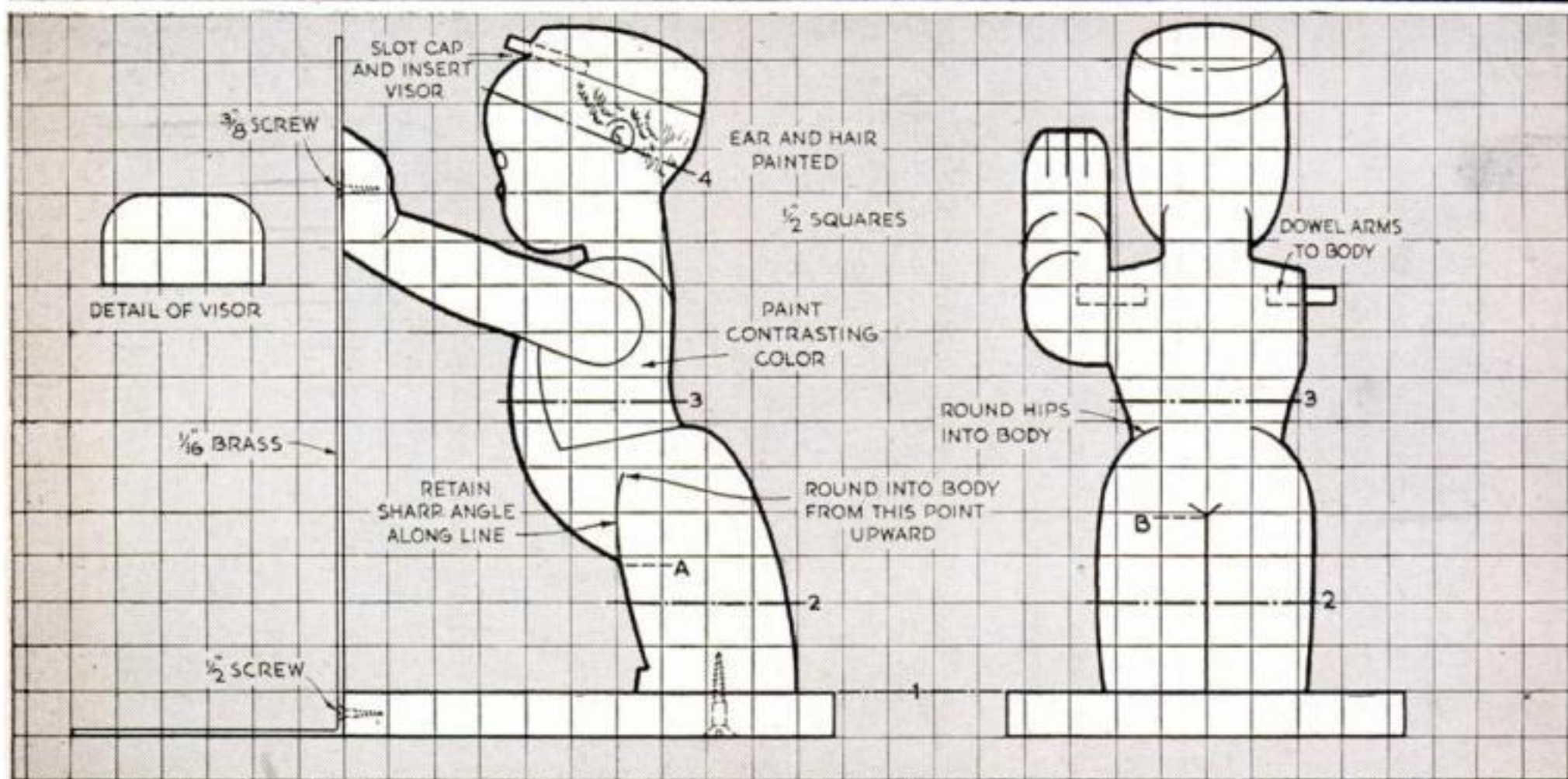
By JUAN OLIVER

IT'S NO trouble at all for this vigorous young man to hold up a number of heavy books without faltering, and he will cause many a chuckle as he does so. You can carve Sturdy Steve from sugar pine, whitewood, or straight-grained hardwood. By using cardboard templates, even a beginner should be able to make this appealing little piece.

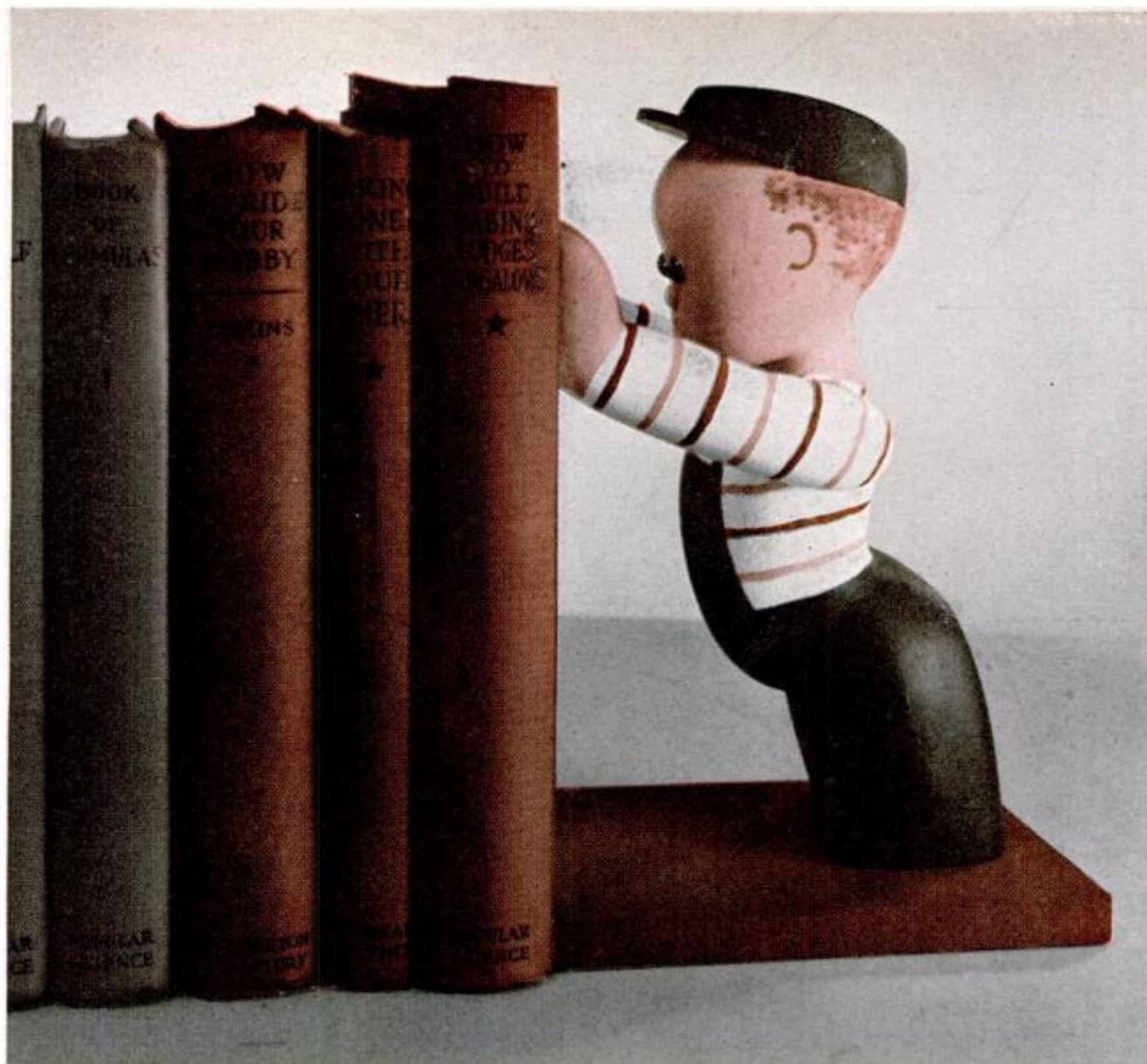
The arms are carved separately and doweled to the body. For the latter, glue up two or three pieces of wood into a block  $2\frac{3}{8}$ " by 3" by 8", transfer side and rear-view pro-



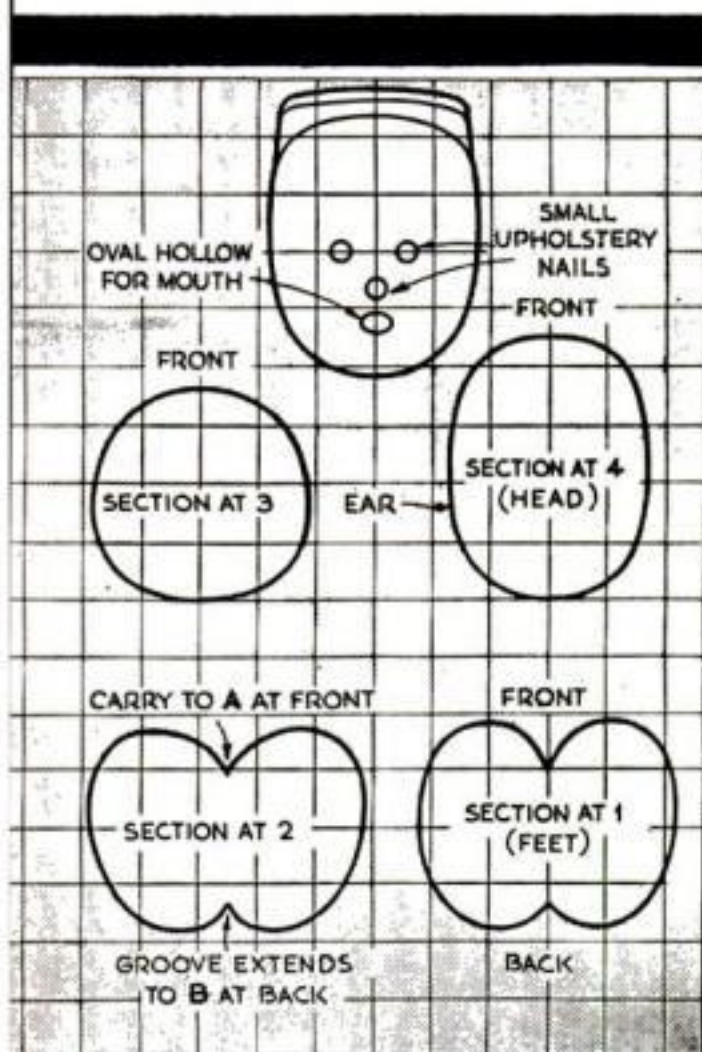
These four photos give an all-around view to aid in carving the figure. They are approximately one third full size







The arms are made separately and doweled on. Below are cross sections to use in preparing templates



files to it, and band-saw to shape. In carving, avoid attempting intricate detail. The design requires simple treatment to bring out its charm, and overelaboration will spoil it. Let the curves be full and massive. The hands are kept very simple, although the fingers may be indicated by three narrow grooves if desired.

Cut a  $\frac{1}{8}$ " slot in the cap, and shape and insert the visor. Use roundheaded upholstery tacks for eyes and nose. Dowel and glue the arms in place and check to see that the feet and palms of the hands form a true right angle.

Give the base and the figure a coat of flat white paint or enamel undercoater. After this is thoroughly dry, the hands and face may be colored pink, the eyes and overalls blue or black, the sweater white, and the base red. Paint in straps over the shoulders and down the back. An attractive texture is obtained by stippling the paint while applying it. Red and pink stripes may be painted on the sweater.

The brass sheet is bent squarely to a right angle, buffed to a high polish, and coated with clear brushing lacquer. Drill holes opposite the hands and the base. Countersink these for small brass wood screws, and assemble.

A novel, although less realistic, effect might be obtained by cementing a mirror to the brass upright. This would enable one to see Steve's face from almost all angles.





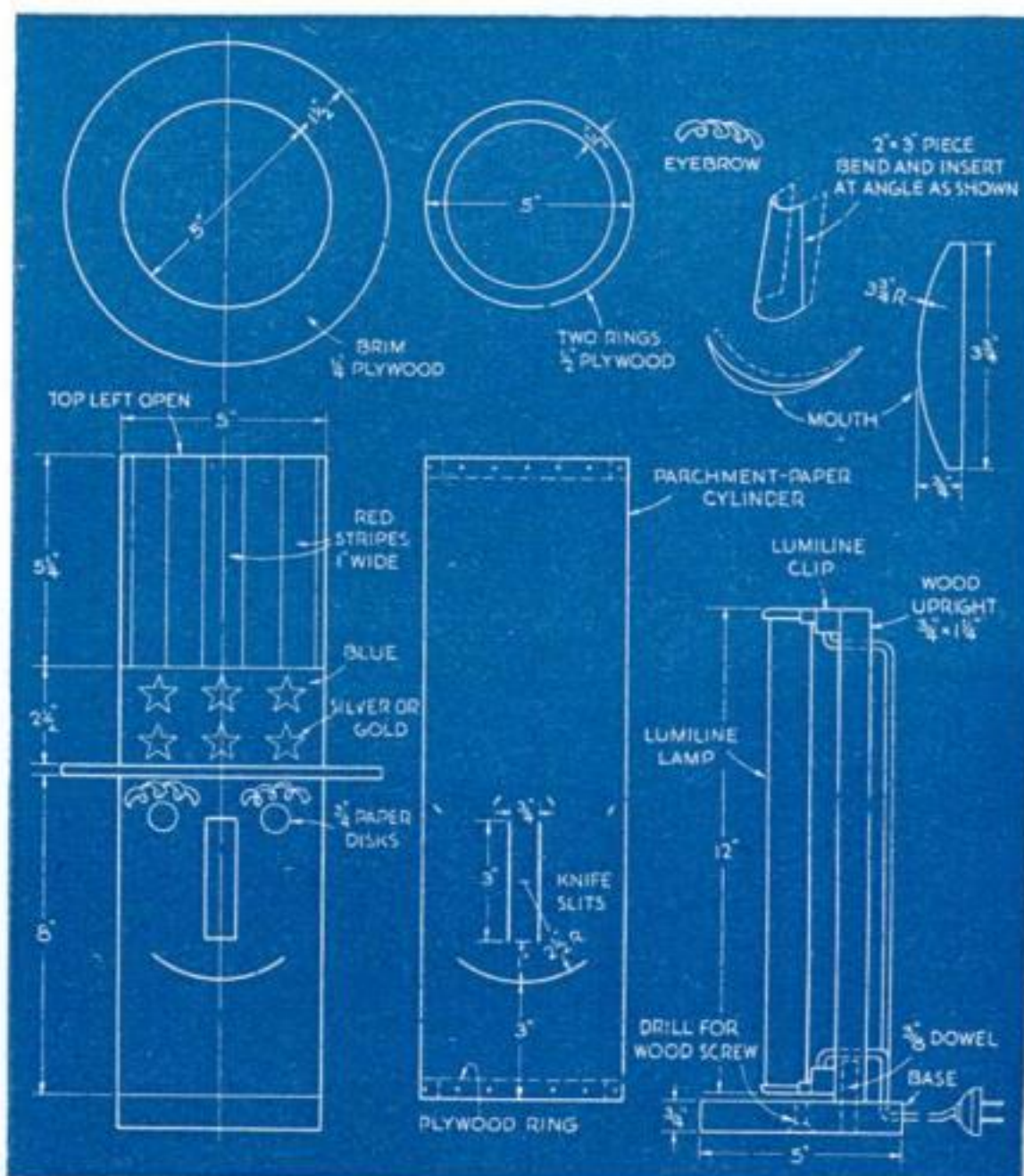
# Uncle Sam Novelty Lamp

Juan Oliver designed this lamp as a modern patriotic ornament for bazaars, parties, and store windows

**C**HIN whiskers are out of date, but this modernized Uncle Sam retains his smile and beetling brows, and will liven up—and illuminate—any patriotic occasion. Lamps of this type are appropriate for the tables at Red Cross bazaars, patriotic benefits, service men's parties, and similar gatherings. They humorously point up window displays and delight children either for party use or as permanent lamps in the nursery.

Each lamp requires two rings of  $\frac{1}{2}$ " plywood, a hat brim of  $\frac{1}{4}$ " plywood, and a base of  $\frac{3}{4}$ " material. In the middle of a 16" by 16 $\frac{1}{2}$ " sheet of parchment paper cut slits for the eyebrows, nose, and mouth. Roll the paper around the two rings and cement it with about a  $\frac{1}{2}$ " overlap. Nail the cylinder to the rings at top and bottom with escutcheon pins.

Colored cellulose wrapping material, crêpe paper, or tissue can be used for decorating the hat. Cement the 2 $\frac{1}{2}$ " wide blue band 8" below the top. Add blue or gold stars, which can be purchased at most stationers. Red decorative tape or strips of



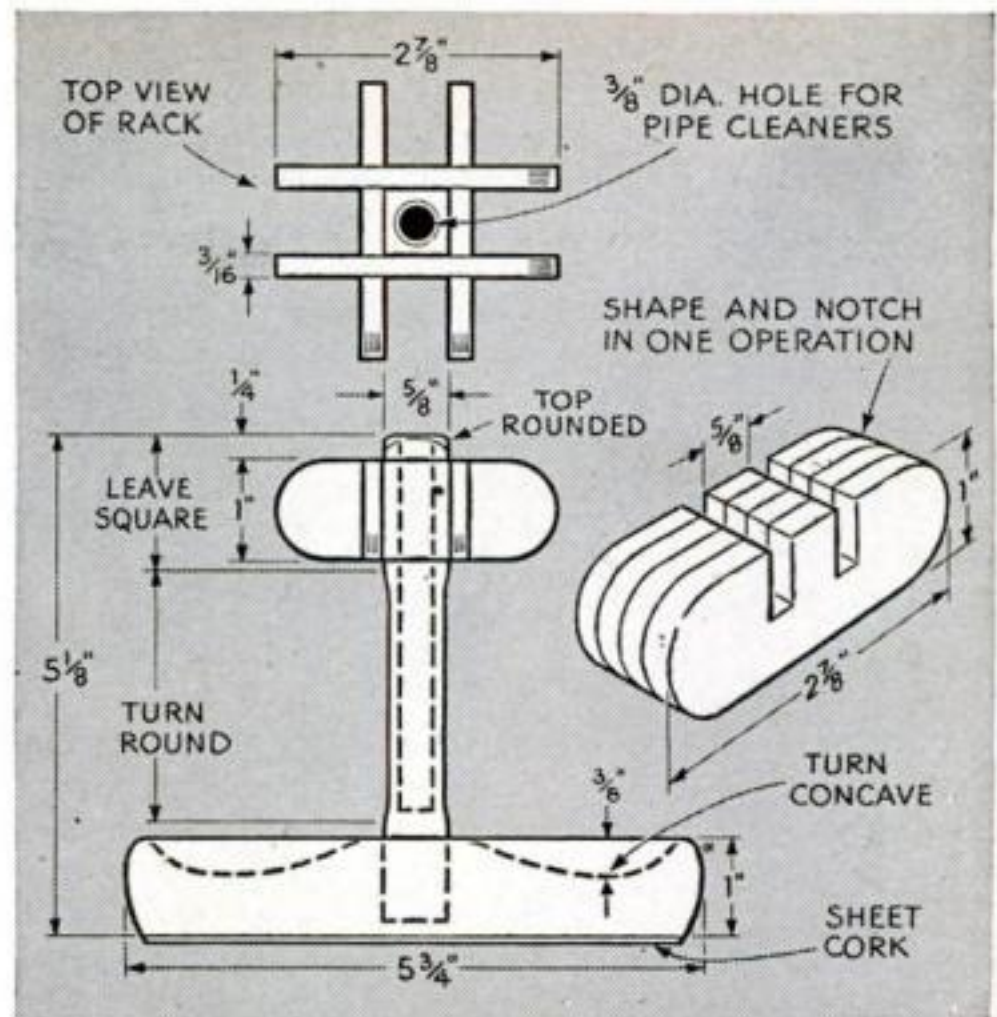
paper may be used to form the red stripes.

Slide the plywood hat brim into position and tack fast from inside the cylinder. Bend and insert the nose and mouth. Form the eyebrows of 8" long strips of parchment,  $\frac{1}{4}$ " wide, which may be lightly colored with crayons for added contrast if desired. For eyes use two  $\frac{3}{4}$ " disks of blue paper or wrapping material.

Drill the base for the lamp cord and for two wood screws, which are to hold the base to the lower plywood ring. Dowel and glue fast the wooden upright, and mount and wire the lumiline-lamp clips. If a tubular lamp with a screw-type base is used, omit the wooden upright and fasten a porcelain socket directly to the base. Enamel the hat brim and the exposed edge of the base white.

After inserting the bulb, fasten the base to the cylinder with two countersunk screws.





Average Time  
4 hours

## Compact Rack of New Design Will Hold Eight Pipes

**D**ESIGNED to save space, this walnut rack holds from four to eight pipes and a generous supply of cleaners.

The base is band-sawed from 1" stock to  $5\frac{3}{4}$ " in diameter, then mounted on a faceplate and turned concave as shown. As a gauge, it is advisable for the beginner to prepare a full-size template. The  $\frac{1}{2}$ " center hole should be bored on the lathe to a depth of  $\frac{3}{4}$ ".

Turn the upright stem to a press fit in the

base, but leave it  $\frac{5}{8}$ " square for  $1\frac{1}{4}$ " from the top. Bore a  $\frac{3}{8}$ " hole  $3\frac{3}{4}$ " deep for the pipe cleaners. Four stem holders are shaped from  $\frac{3}{16}$ " stock. The half-lap joints can be made accurately by clamping the four pieces together, or nailing them through waste wood, and cutting them all in one operation. Glue the parts together.

For a "pickled" finish, rub flat gray paint into the pores, allow to dry, then wax and polish. Felt, cork, or blotting paper is glued to the underside of the base to guard against scratching polished surfaces.—E. R. D.

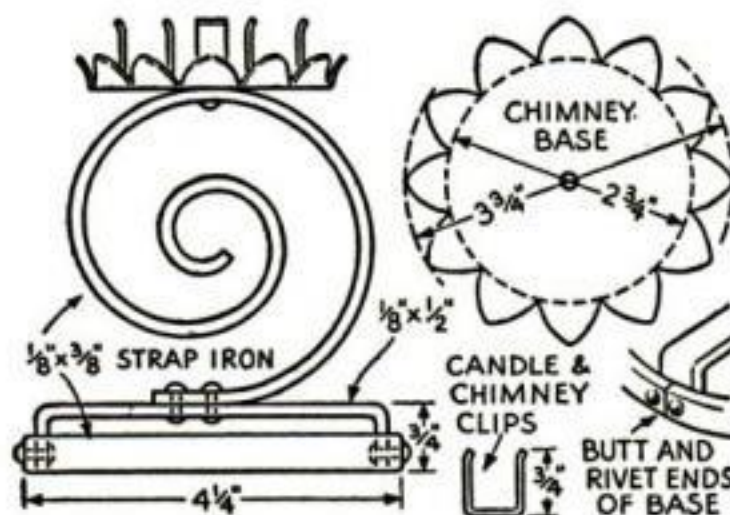
## Wrought-Iron Hurricane Lamp with Attractive Spiral Base

**V**ERY little material is required for the construction of this ornamental hurricane lamp, and it offers the craftsman an opportunity for wrought-iron work. The circular base is formed from  $\frac{1}{8}$ " by  $\frac{3}{8}$ " strap iron, the ends butt-joined and riveted to a crosspiece of  $\frac{1}{8}$ " by  $\frac{1}{2}$ " strap iron. Bend the spiral bracket to shape with a wrench if a bending fork is not available, and rivet to the crosspiece on the base. Scallop and bend upward the edges of sheet copper for the chimney base, and fasten to the upright with a  $\frac{1}{8}$ " soft iron rivet.

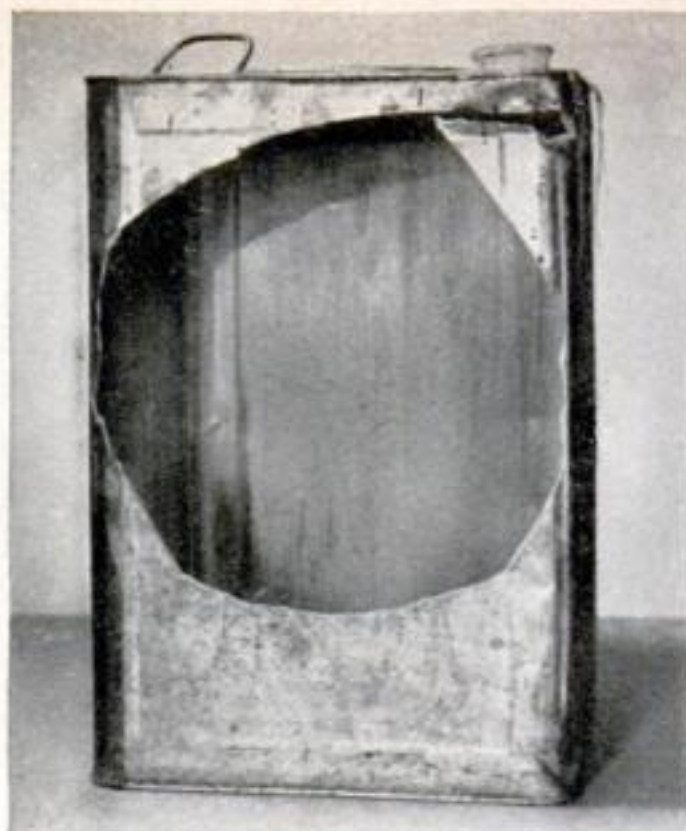
Strips of spring brass that form the chimney and candle clips are bent and soldered to the chimney base. Since the size of candles and chimneys varies, draw a full-size pattern before cutting and bending the clips.—HENRY HANSCOM.



Average Time  
3 1/2 hours







# Craftwork Spun from Tin Cans

**By R. H. JENKINS**

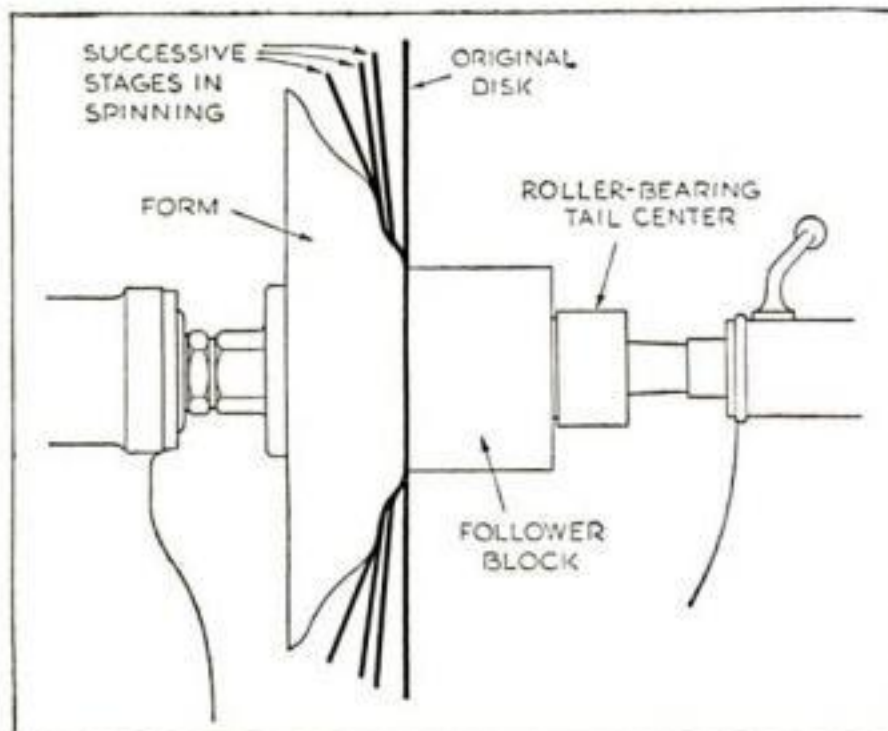
Professor of Industrial Education,  
Humboldt State College, Arcata, Calif.

**N**OW that aluminum can hardly be obtained for craftwork, and other metals also are in great demand for defense purposes, what is the amateur to do if he wants to master the art of metal spinning? The answer is an easy one, although many experienced spinners would scoff at it. Just use tin cans!

The thin sheet iron from these can be transformed into many beautiful, useful objects. This material costs nothing, and a few cents' worth of lacquer or enamel will finish several ash trays, bowls, dishes, or similar objects. If you wish to make articles for sale, spun projects merit your attention because they can be turned out quickly in quantity.

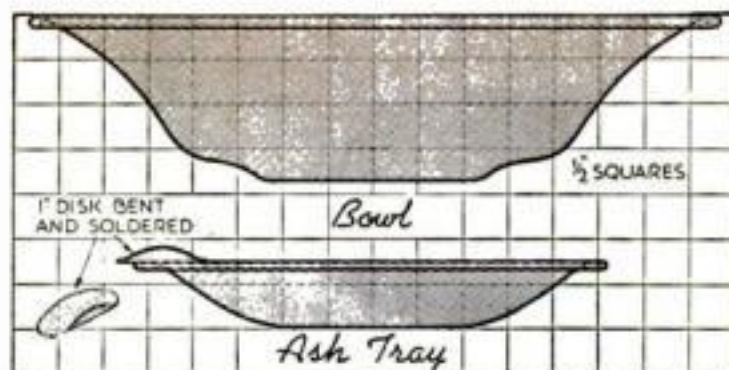
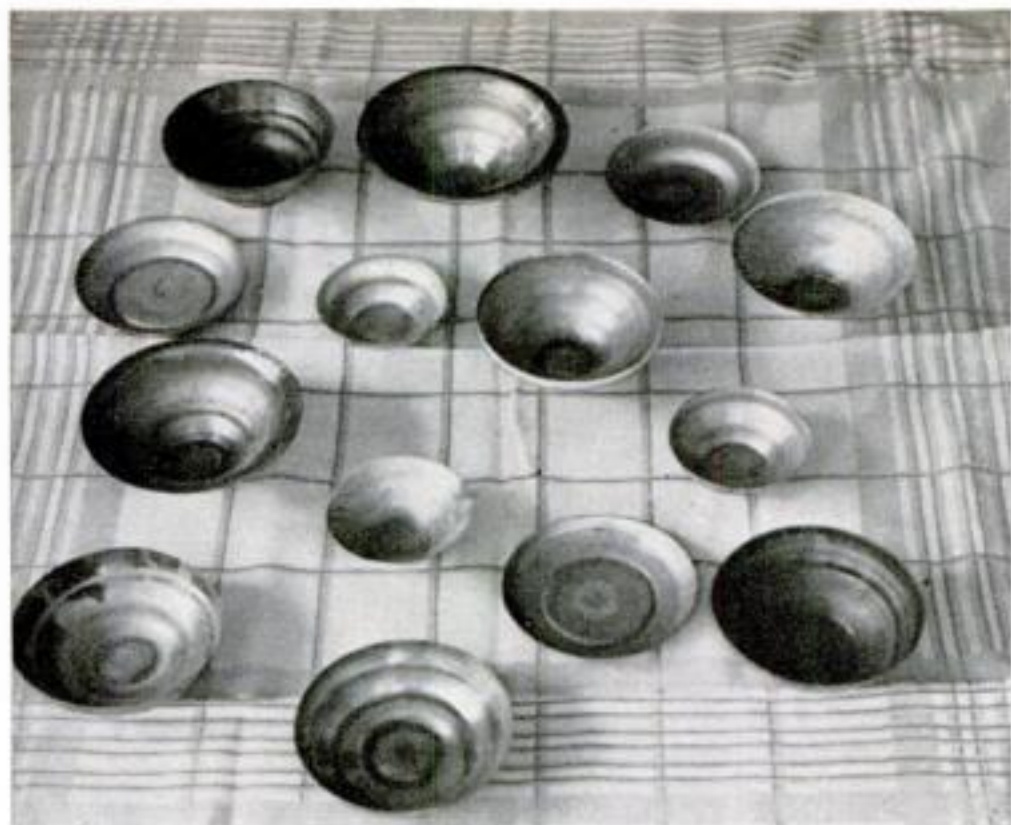
The lathe used should have bearings capable of withstanding heavy thrust loads and speeds up to 1,800 r. p. m. A heavy-duty tail center can be improvised from a used automobile roller bearing as shown in the drawings. The socket for it is turned from metal or hardwood.

It can be done! The dish above was spun from metal cut from the can shown beside it. At left, a maple backing stick supports the disk directly behind the tool in early stages of spinning, shown below



POPULAR SCIENCE





Spinning is one of the fastest types of craftwork. The bowls at left were spun by a beginner in one evening. Above, profiles of dish on facing page and of an ash tray. A grooved roller produces the beaded edges

Spinning tools can be made by brazing steel balls to suitable shanks. On one such tool the ball should be ground flat on one side, as shown. Tools can also be shaped by filing steel rods to a more or less blunt point in the lathe. The ends must be hardened, polished with emery cloth, and burnished to mirror brightness on a buffing wheel with pumice stone or other fine abrasive.

Fasten all the tools firmly in long wooden handles, which are necessary to obtain leverage. Use a ferrule or wire binding to prevent splitting.

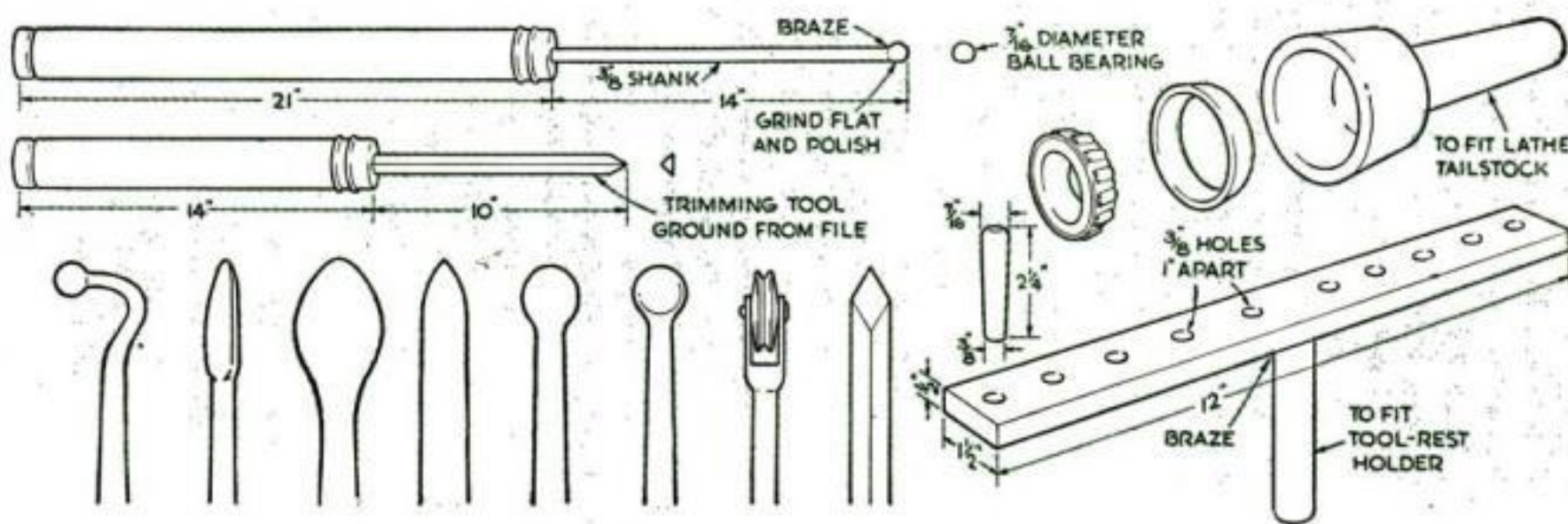
Mount a hardwood disk on the faceplate of the lathe and turn it to the profile of the piece you wish to spin. Choose a rather shallow shape for your first attempt. Mark the exact center of the form and drive in a small escutcheon pin until only the head protrudes.

Cut a disk of sheet metal slightly larger than the diameter of the finished piece is to be. Dot the center with a punch and place this indentation over the head of the es-

cutcheon pin. A hardwood disk, slightly smaller than the base of the form, is placed against the metal and supported by the tail center. Start with a medium speed, and lubricate the disk by holding a candle against it. Hold a blunt-ended tool with the handle under the right arm and the working end rather low on the spinning disk. With the tool-post pin as a fulcrum, press the metal against the form, working outward only as fast as the spinning takes shape. It must fit the form snugly from the start, as the piece will be spoiled if the base portion is a loose fit.

Keep the tool in motion to avoid burning the metal, and reverse the direction of pressure occasionally in order to build up the disk where it has been thinned by spinning. Avoid forcing the work. Should ripples occur, they can be removed by taking the metal off the form and hammering with a mallet.

Spun articles can be burnished with emery cloth or steel wool in the lathe, and later buffed or finished with enamel. Polished brass and copper should be coated with clear lacquer to prevent tarnishing. Pewter may be left to age to its characteristic patina, and aluminum requires no lacquering.



The inner bearing race projects from the cup to bear against the follower block (see drawing opposite). Various types of tools are shown, including a roller for forming beads. Tools must be hardened



# New Appliances



Special fingers on inner nozzle loosen and pick up matted dirt



**CLEANING DRAPES** is simplified by this new vacuum extension tube which has slots operated by thumb to control suction when used on light fabrics. A nozzle within a nozzle, lowered by slight pressure, will pick up hard-to-get dirt and return to its normal position when pressure is released

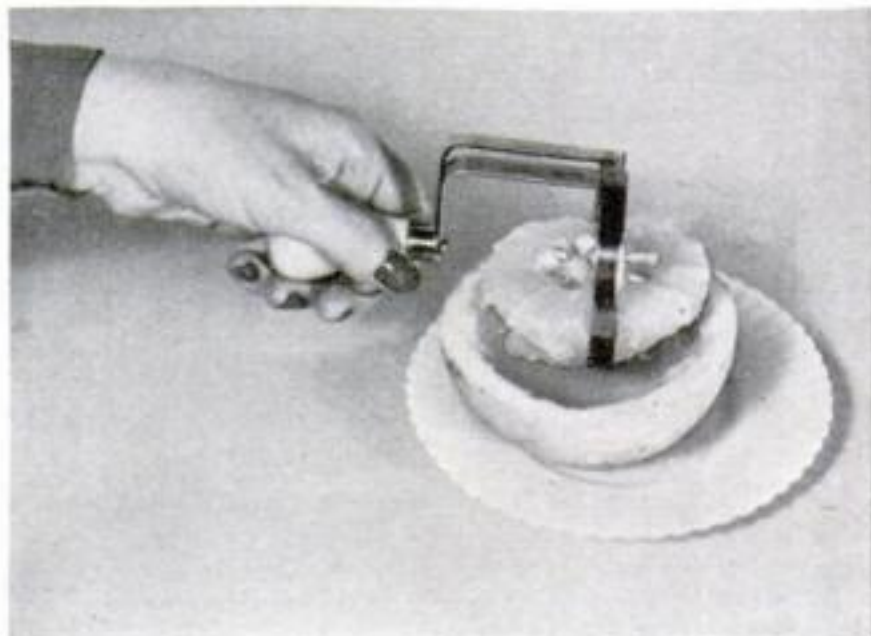
**AN ELECTRIC SHARPENER** for knives plugs in any ordinary household A.C. socket to give a professional finish to cutlery in a few seconds. A fan-cooled motor spins the grinding wheel. The machine is 8" by 4"



**SUDS WITHOUT SOAP** come from these cubes, packed thirty to the box and individually wrapped. One cube will do a washing and is enough for a small tub. Useful for Nylon, silk, and wool, where a quick rinse is needed, the suds also will save work on dishes, silver, and glassware, which will drain dry without wiping after a hot water rinse



**GRAPEFRUIT CENTERS ARE SEPARATED** quickly from the skin with the stainless-steel device below. Adjustable to any grapefruit between 3" and 4" in diameter, the knife blade cuts the fibers holding the juicy sections with one motion, speeding the preparation of breakfast. The peeler can also be employed to lift the centers out and onto a plate

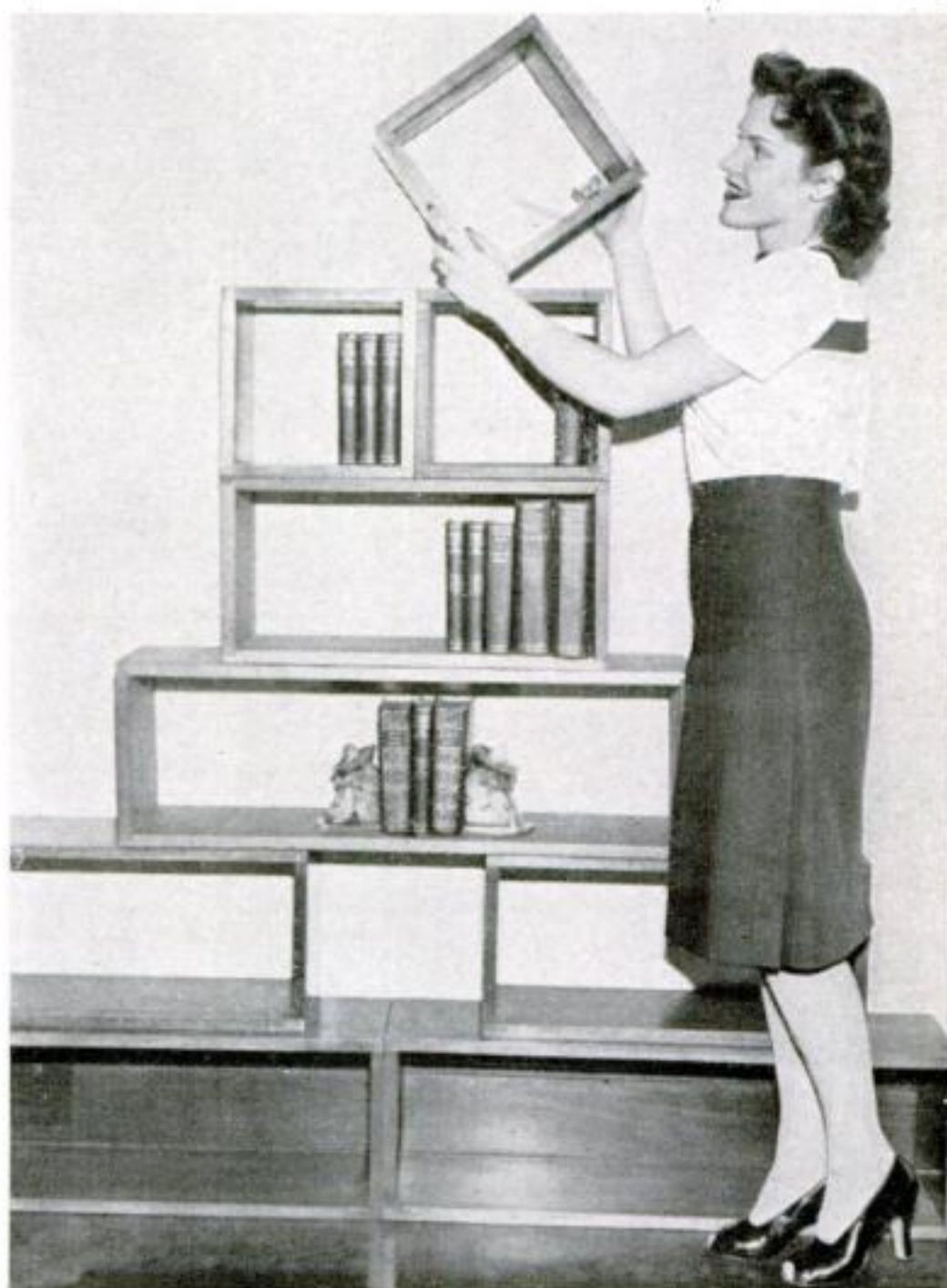




# for the Household

**MODERN BOOKSHELVES** can be designed at home to the individual's taste or to fit the room's needs from these square and rectangular sectional cases. There is hardly a combination that cannot be arranged to cover wall space or fill an empty place between pieces of furniture

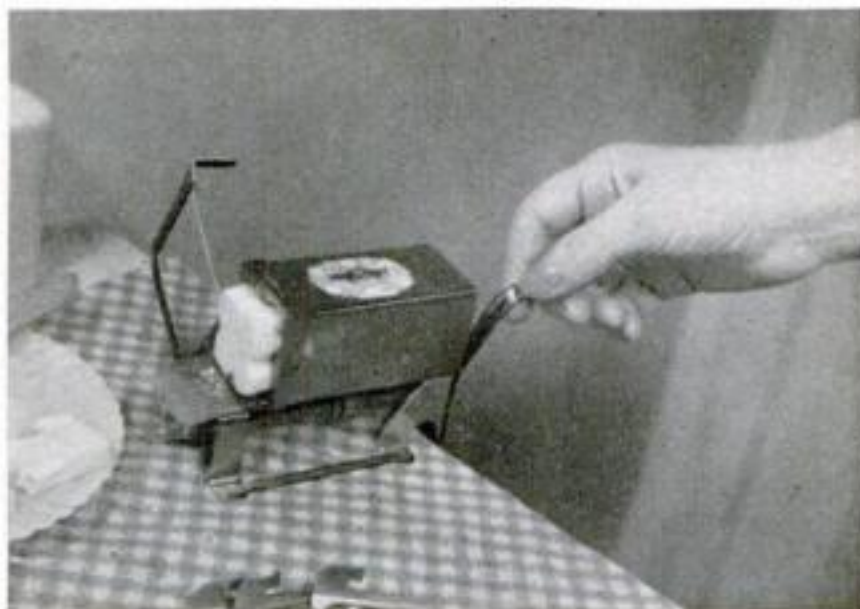
**A SHAVING BRUSH** dries quickly and lasts longer with the pronged stand shown below. Excess water is first shaken off and the brush hung, bristles down. Remaining moisture drips into the base



**SLOW-BAKED BEANS** are cooked by electricity in a crock-lined automatic stove to bring out all the natural flavor of the old-fashioned home dish. No attention is required for this A.C.-D.C. unit, which comes in 1½-quart and 3½-quart sizes. It can also be used for any other slow-heat casserole purpose or the preparation of roasts, puddings, and stews



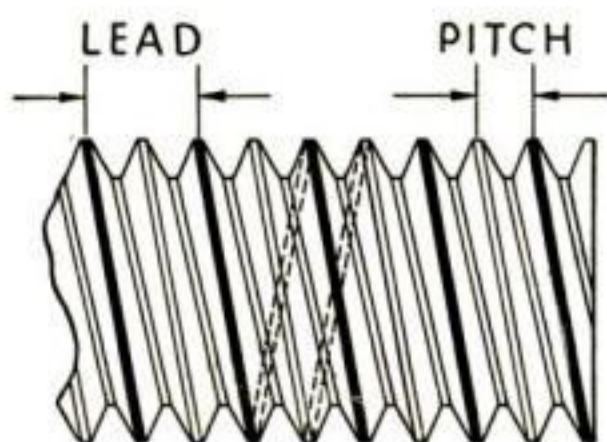
**BUTTER, CHEESE, AND ICE-BOX COOKIES** come in familiar bridge-deck shapes from this rustproof slicer. It is exactly the size of a quarter pound of butter, and a crank-operated pusher forces the butter, cheese, or dough through the opening, where it is sliced to the desired thickness by a wire of stainless steel. The design can be changed at will





## THREAD-CUTTING TERMS

[LATHE WORK—17]



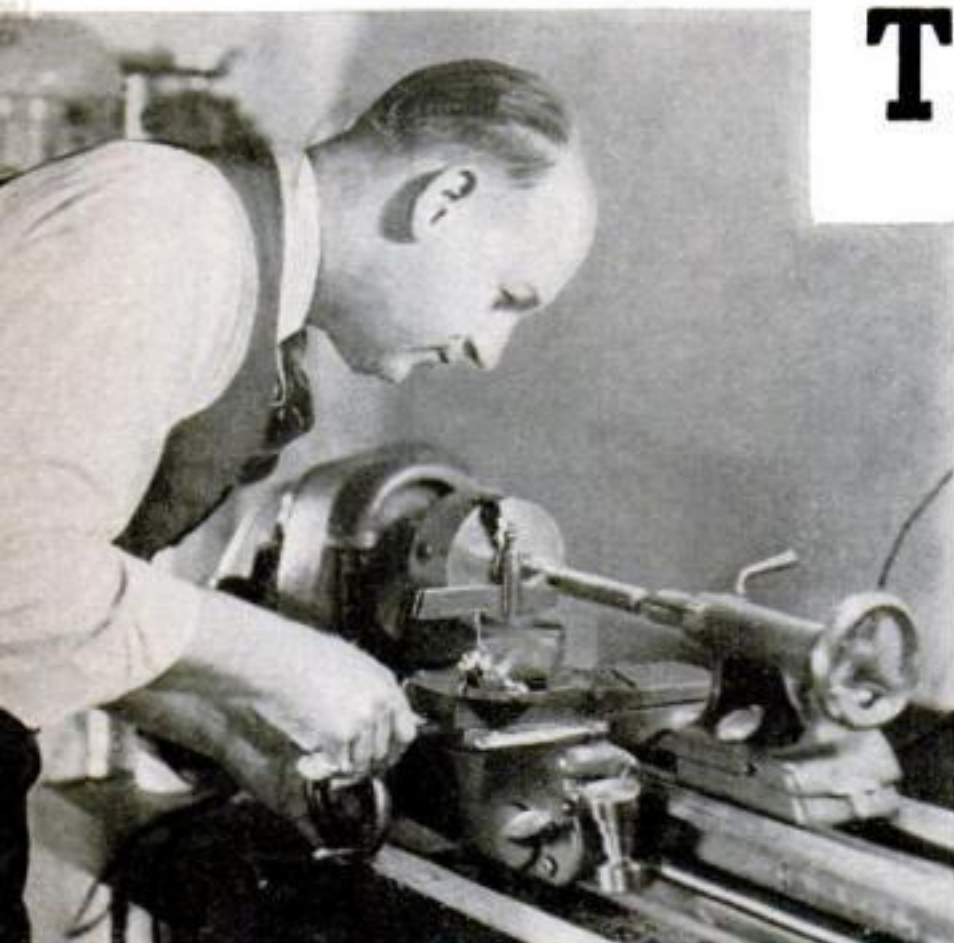
**SCREW THREAD.** A ridge of uniform section in the form of a helix on the surface of a cylinder or cone.

**EXTERNAL AND INTERNAL THREADS.** An external thread is a thread on the outside of a member, as on a threaded plug. An internal thread is a thread on the inside of a member, as in a threaded hole.

**PITCH.** The distance from a point on a screw thread to a corresponding point on the next thread, measured parallel to the axis.

**LEAD.** The distance a screw thread advances axially in one turn. On a single-thread screw, the lead and pitch are identical; on a double-thread screw, the lead is twice the pitch; on a triple-thread screw, the lead is three times the pitch; on a quadruple-thread screw, four times, and so on. A double-thread screw is illustrated.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



# Thread Cutting

OF ALL operations made possible by the metal-turning lathe, thread cutting holds the deepest interest and deserves the greatest care and study. As a help to standardizing threads in the United States, a report of the National Screw Thread Commission was prepared in accordance with a 1928 Act of Congress, and the terms used in thread cutting were defined officially. Some of these definitions, given on the accom-

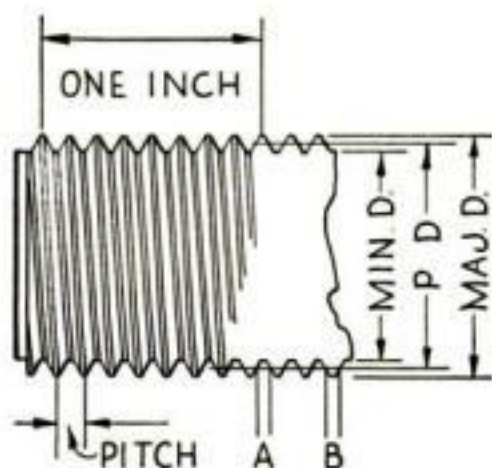
A beginner should use a slow speed, such as 28 r.p.m., for threading. Start with a shallow cut (0.003" for example), continue with deeper cuts (0.005"), then make the final finishing cuts as shallow as the first one

## THREAD-CUTTING TERMS

[LATHE WORK—18]

**MAJOR DIAMETER.** Largest diameter of the thread of the screw or nut.

**MINOR DIAMETER.** Smallest diameter of the thread of the screw or nut.



**PITCH DIAMETER.** On a straight screw thread, the diameter of an imaginary cylinder, the surface of which would pass through the threads at such points as to make equal the width of the threads and the width of the space cut by the surface of the cylinder. (Thus, A equals B.) On 60-deg. V-type and National Form threads, the pitch diameter is the major diameter less the depth of thread.

**DEPTH OF THREAD.** Half the difference between the major and minor diameters.

**THREADS PER INCH.** The number of complete threads in the space of one inch. In the diagram there are eight, therefore, the screw is  $\frac{1}{8}$ " pitch or eight threads per inch.

POPULAR SCIENCE MONTHLY SHOP DATA FILE



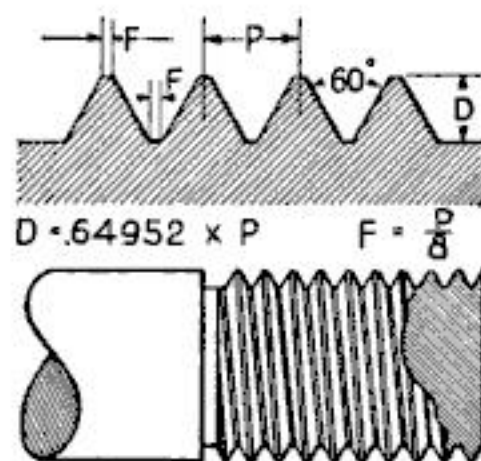
## NATIONAL FORM THREAD

[LATHE WORK-19]

The American National Screw threads, both National Fine and National Coarse, are practically standard for automotive and machine shop work in the United States. These threads are 60-deg. V-threads with points cut off so that the depth is 75 percent of the depth of a V-thread of the same pitch. The tool is generally ground for cutting sharp-pointed V-threads and the thread is cut with the regulation V-bottom, but the top is left with the proper amount of flat. Only when the utmost strength is needed should the tool be ground to the exact National form.

The tool, however, may be ground to cut an exact National Form V-thread by flattening the sharp point so that it will fit in the selected slot in the Na-

tional Form thread gauge. The general sharp-pointed 60-deg. V-thread screw will work satisfactorily with the National Form nut.



POPULAR SCIENCE MONTHLY SHOP DATA FILE

# in the Lathe

panying shop data file cards, will help the lathe operator to a clearer understanding.

Lathes are equipped with a thread index chart for setting up the change gears required for driving the headstock spindle and the lead screw in their proper ratio. Opposite the desired pitch are listed the number of teeth wanted for both stud and screw gears. For example, should a 1/16" pitch be decided on and the lead screw has

eight threads per inch, the gears should be arranged so that the headstock spindle revolves twice to once for the lead screw.

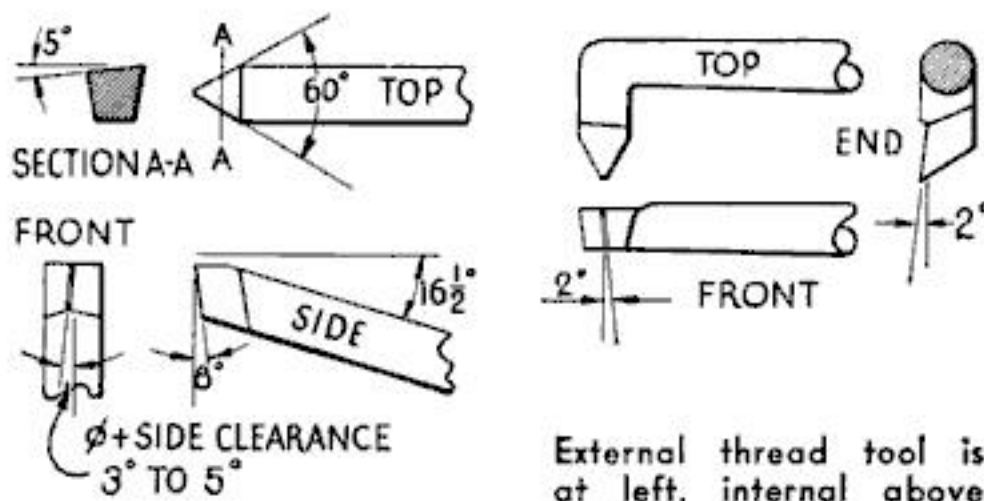
The cutting tool must be ground accurately and with increased clearance because of its rapid advance as the work revolves. Clean threads are impossible unless one side and the front of the tool have enough clearance. In other respects the same general rules for external tool grinding apply.

## TOOLS FOR NATIONAL FORM THREADS [LATHE WORK-20]

Thread tools are ground to the form of the thread desired. Clearance must be increased because of the rapid advance of the cutting tool. Thread tools are ground nearly flat across the top. When the tool is fed into the work at an angle, the tool should have a few degrees of side rake. When fed at right angles, it should have a small amount of back rake.

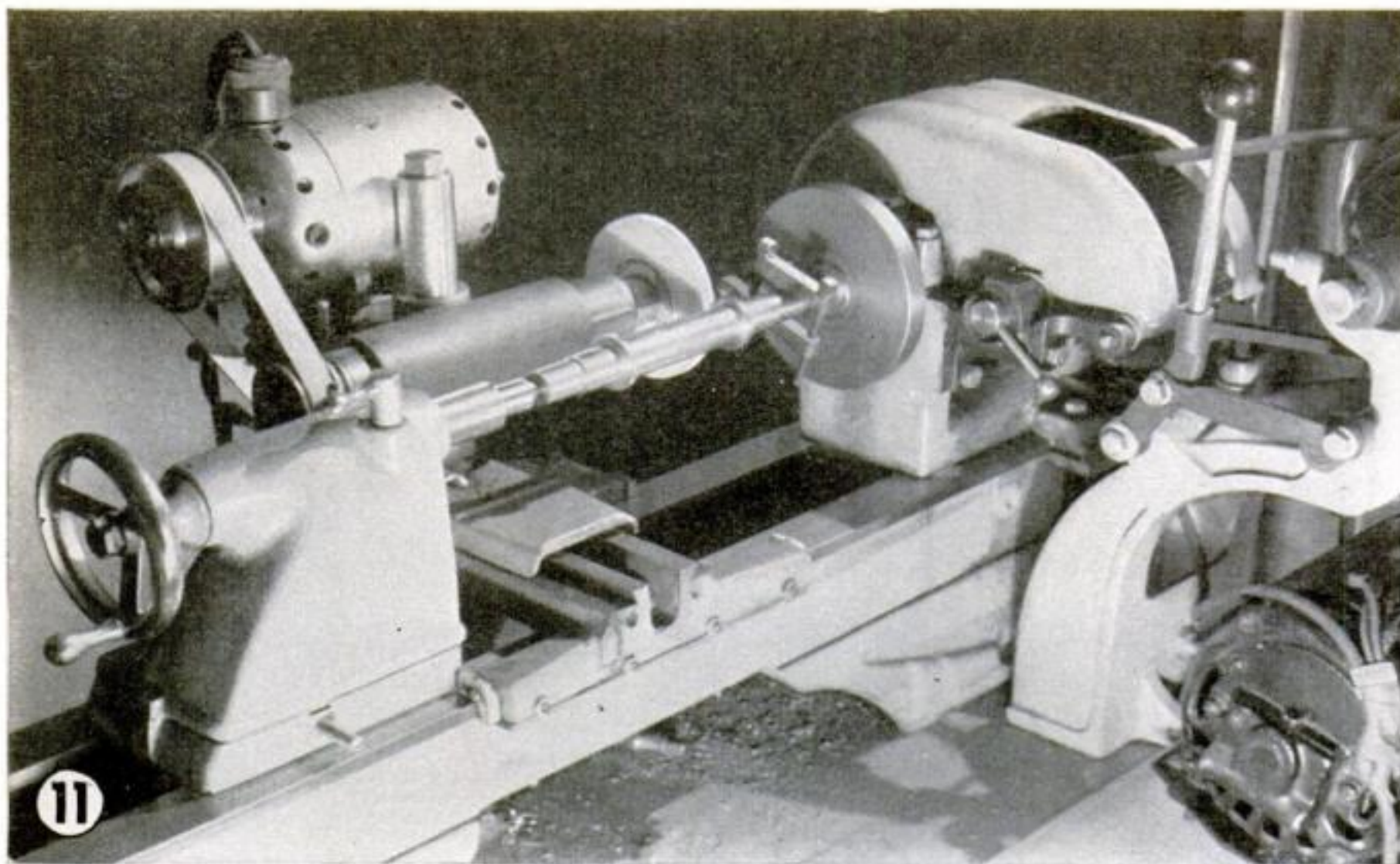
The top of the tool should be placed exactly in alignment with the lathe center for cutting both external and internal threads or the correct angle of the thread cannot be obtained. It should also be set square with the work, using a center gauge, to assure a perfect thread.

In cutting internal threads, allow sufficient clearance for backing the tool out at the end of the cut, using a boring bar as large in diameter and as short as possible to prevent springing.



POPULAR SCIENCE MONTHLY SHOP DATA FILE



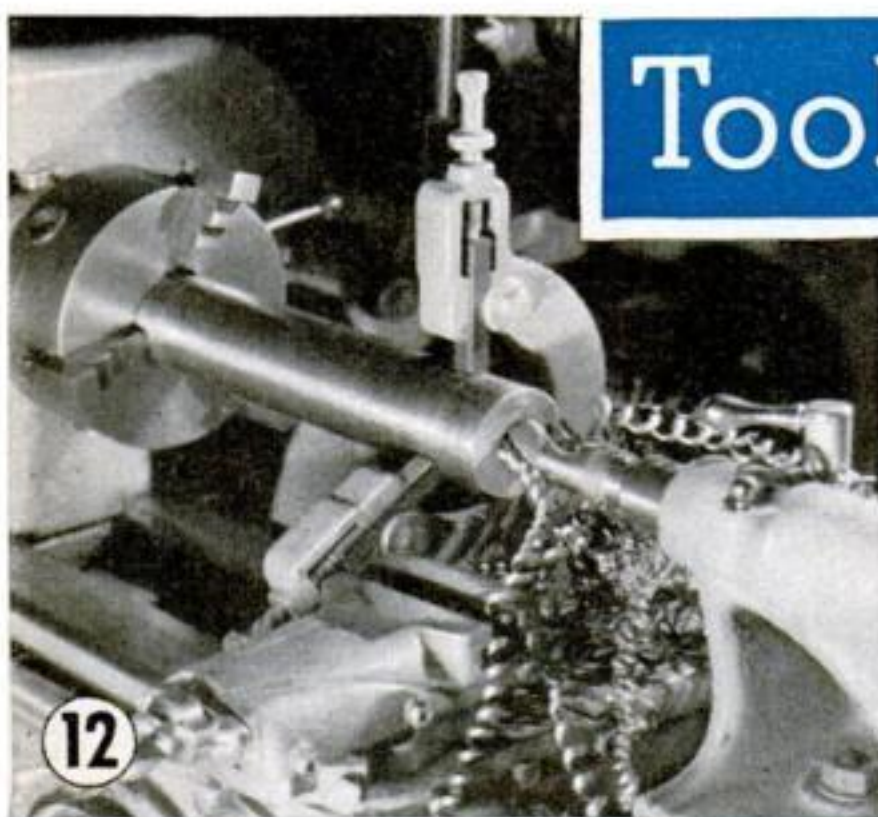


11

## Tool-Post Grinder

### PART TWO

By C. W. WOODSON

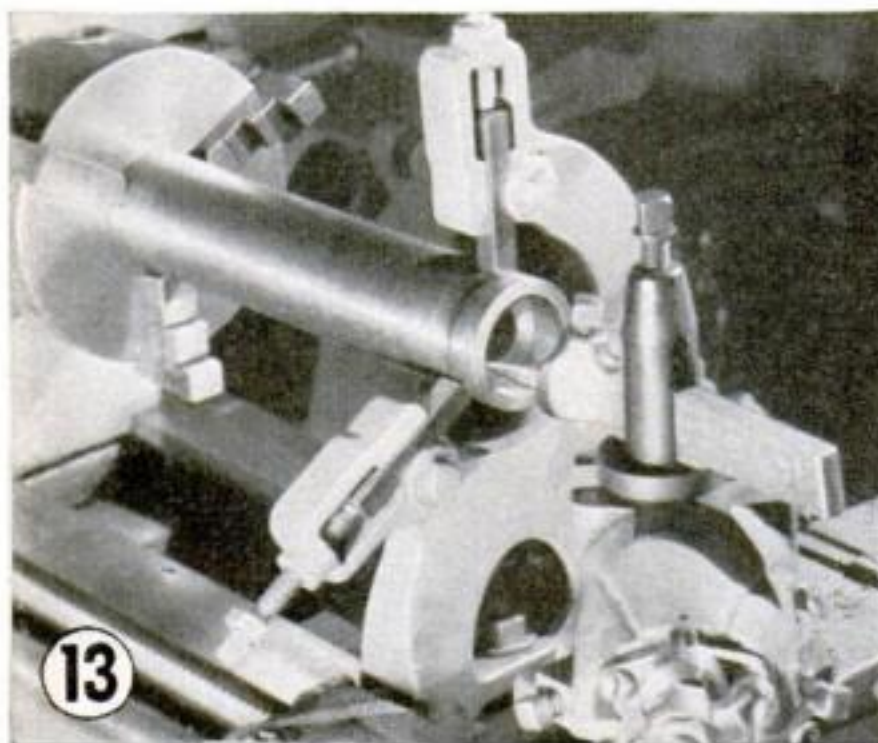


12

**E**ITHER single or double-race ball bearings are suitable for the spindle bearings of the precision tool-post grinder (Fig. 11), provided that they are new and of good quality. The use of salvaged bearings is not recommended. It will be necessary to obtain the bearings before starting work on the quill housing, as the recesses must be turned out to fit these.

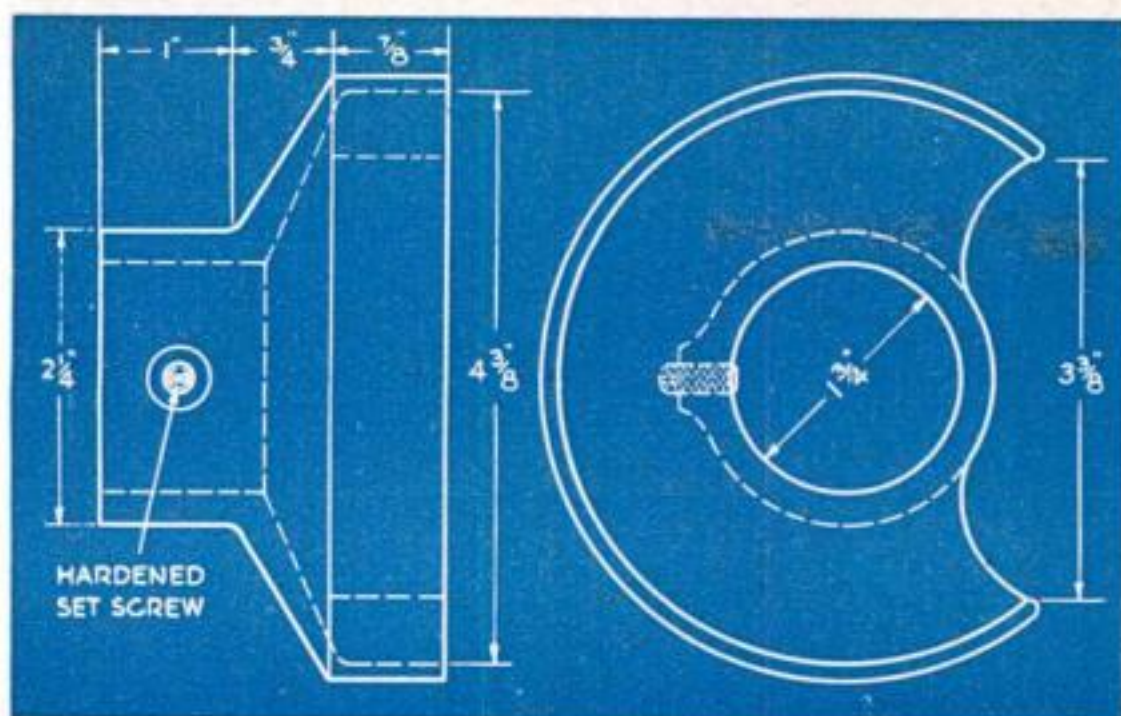
The steel bar from which the housing was made was chucked and supported in the steady rest as in Fig. 12, then drilled through from end to end with a  $\frac{7}{8}$ " drill. Each end was recessed for the bearings (Fig. 13), care being taken to obtain a snug fit so that they could be inserted or removed without difficulty and yet held without play when in place.

The two end caps were turned from steel, the shoulders being made a snap fit in the bearing recesses and wide enough to exert just a slight pressure on the bearings, so as to eliminate all end play. The caps were drilled a clearance size for 2-56 screws, and used for spotting the holes in the ends of the quill housing, which were then drilled



13





Grinding-wheel guard for the precision grinder, made of cast iron and designed for mounting directly upon the quill housing

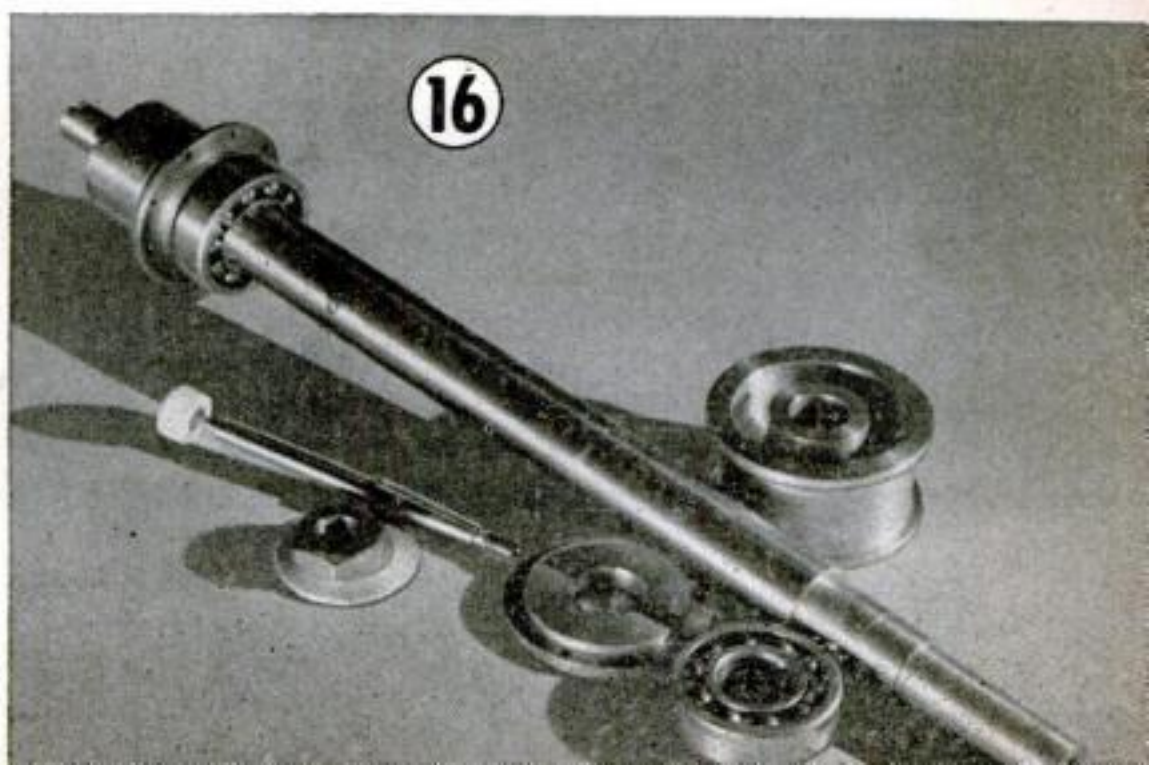
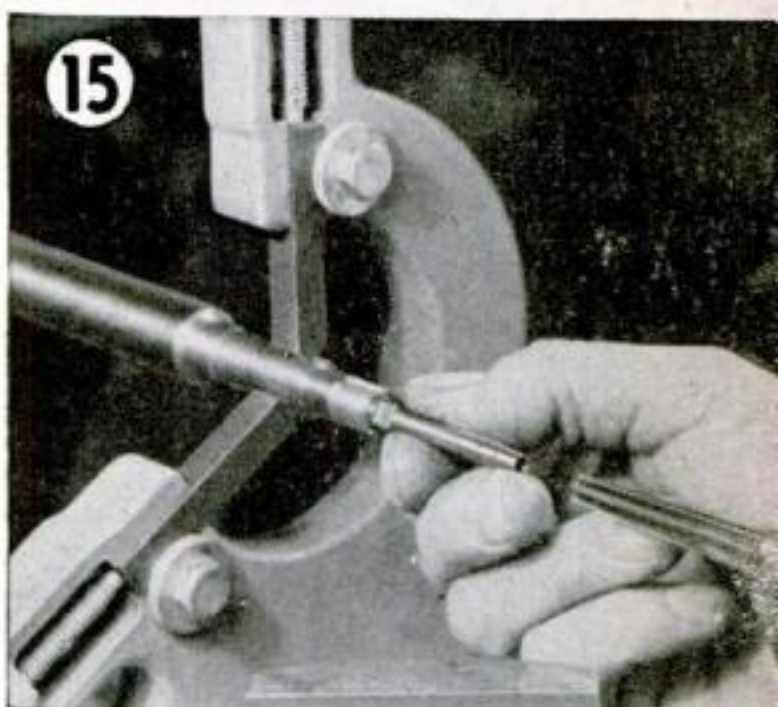
about  $5/16$ " deep as shown in Fig. 14, and tapped 2-56.

The spindle was cut to length from a piece of drill rod, centerdrilled at both ends while supported in the steady rest, and turned to dimensions between centers, the shoulders being made a light drive fit in the bearings. The pulley shoulder on the spindle was turned to exactly the same size as the motor shaft, so that the pulleys would all be interchangeable.

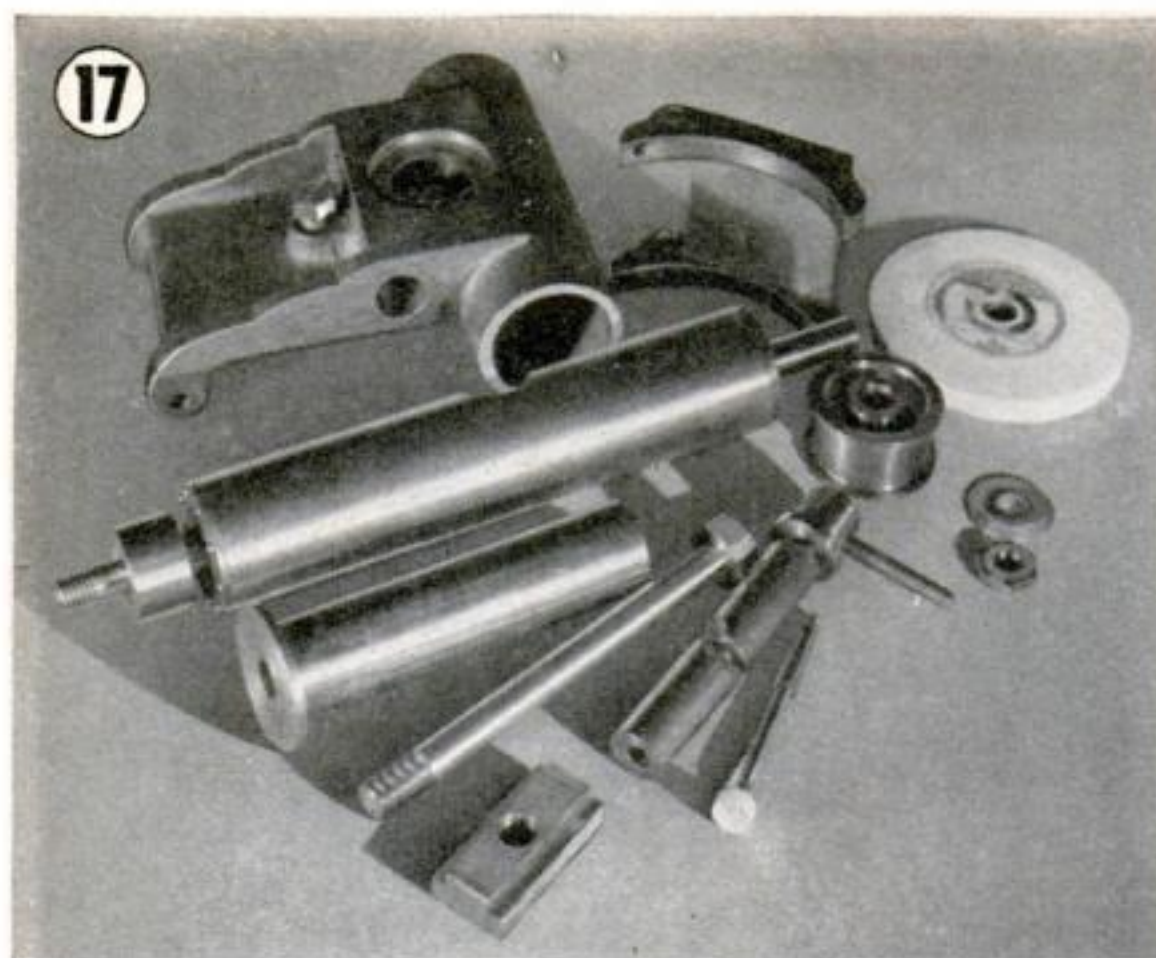
This done, the grinding-wheel end was again supported in the steady rest, Fig. 15, and drilled, taper reamed, and tapped for the internal grinding spindles. These can be made from drill rod, or they can be purchased. The fixed collar on the grinding-wheel end was turned from steel, as was also the recessed washer, thus completing the spindle. All the spindle parts, as well as the small pulley and one of the internal spindles, are shown in Fig. 16.

To obtain various spindle speeds, several sets of pulleys will be required. The larger ones should be made from castings, preferably aluminum; the smaller sizes can be turned from solid steel. Check the speed of the motor by experiment to determine the exact pulley sizes. The dimensions shown in the drawings in the first installment (P. S. M., Aug. '41, p. 170) are those of the pulleys illustrated in the photographs, but the shaft holes should, of course, be made to fit the motor shaft and the spindle. By using the largest pulley on the motor and the smallest on the spindle, the necessary high speeds for the small internal grinding wheels are obtained. By reversing the pulleys, or using intermediate sizes, the lower speeds for the larger wheels can be had. When pulleys are changed, the belt tension is adjusted by means of the set screw under the frame, the motor swinging back to take up any slack.

The assembled quill and the frame parts are shown in Fig. 17, and the assembled grinder in Fig. 18. The grinder is also shown mounted on the







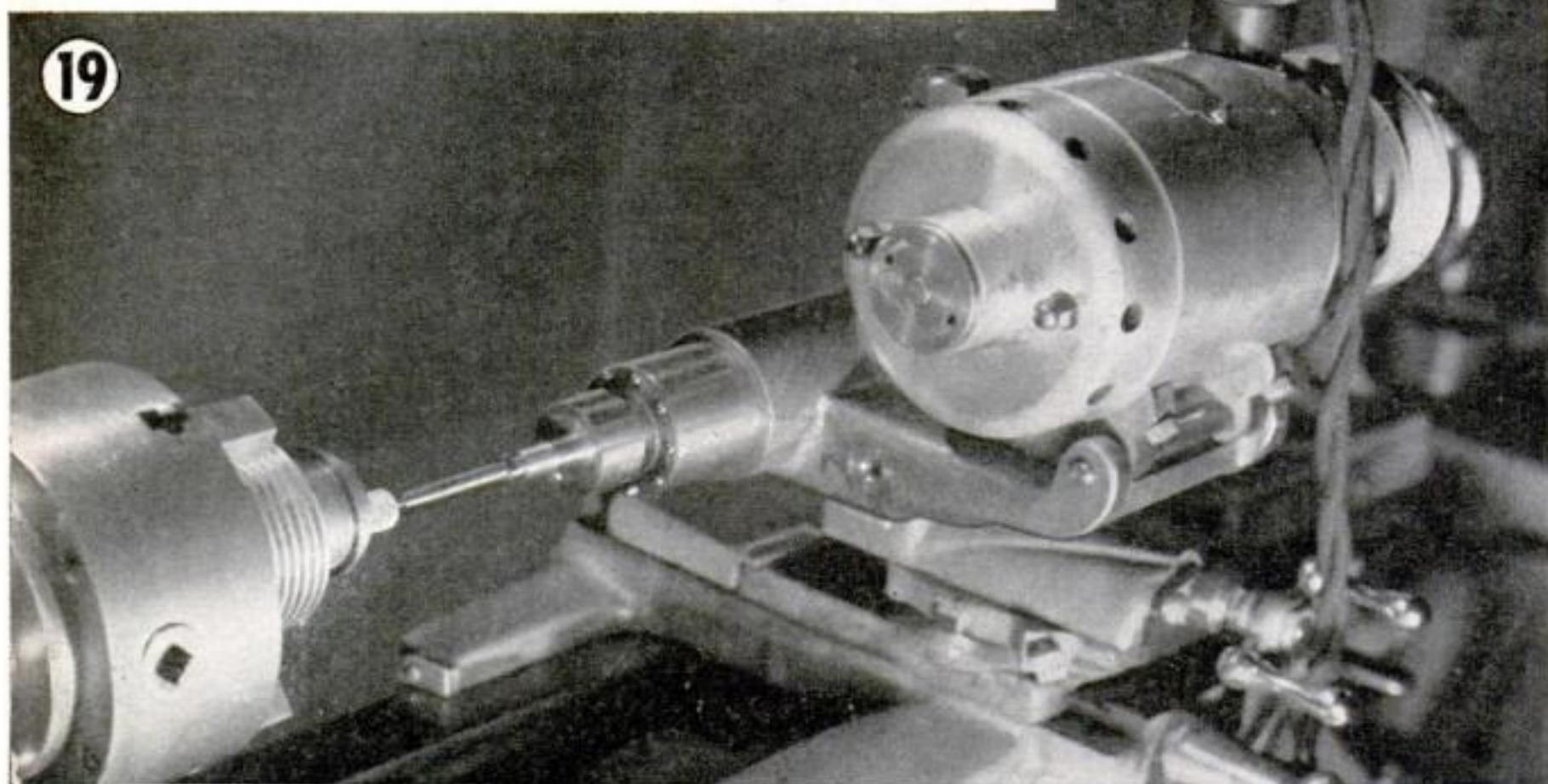
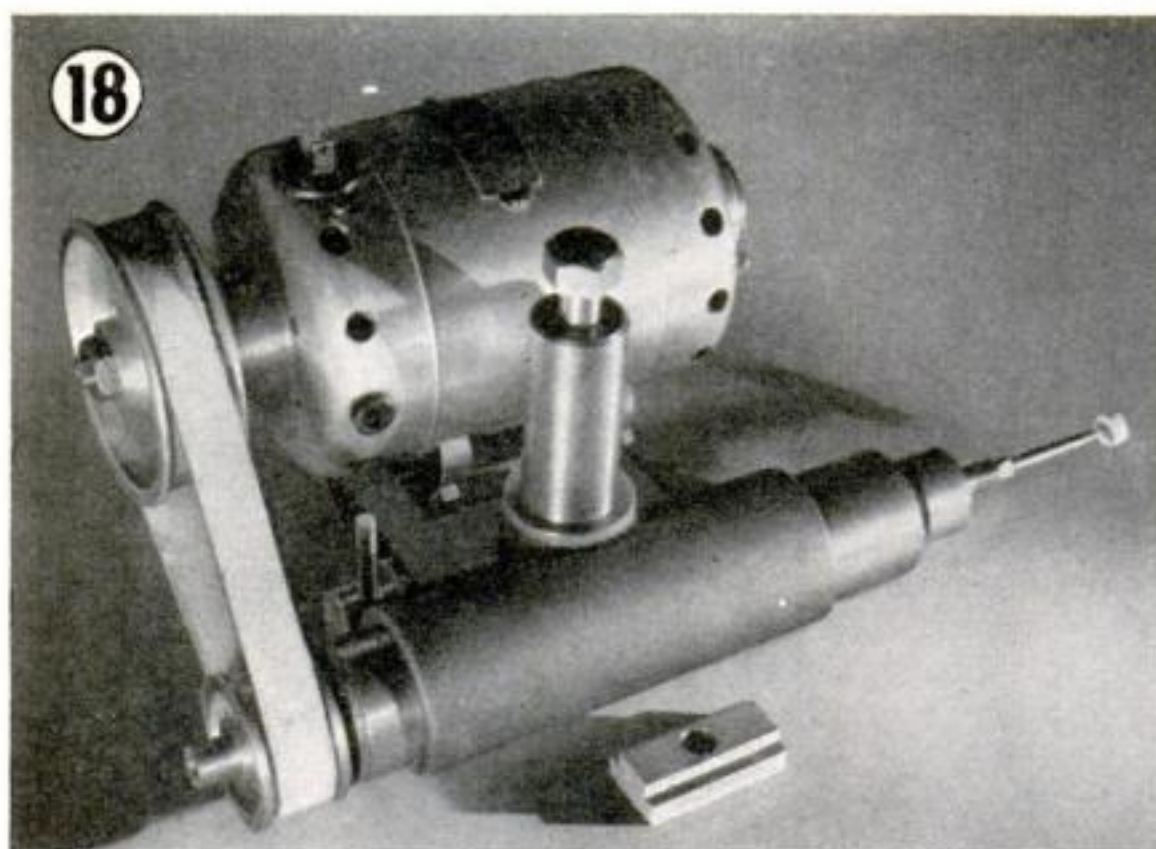
toolpost for internal grinding in Fig. 19, and for external grinding in Fig. 11.

A selection of grinding wheels, such as shown in Fig. 1 in the first part of this article, will be found most useful. It should include a hard and a soft wheel for soft and hardened steel respectively, as well as a special one to use for cast iron.

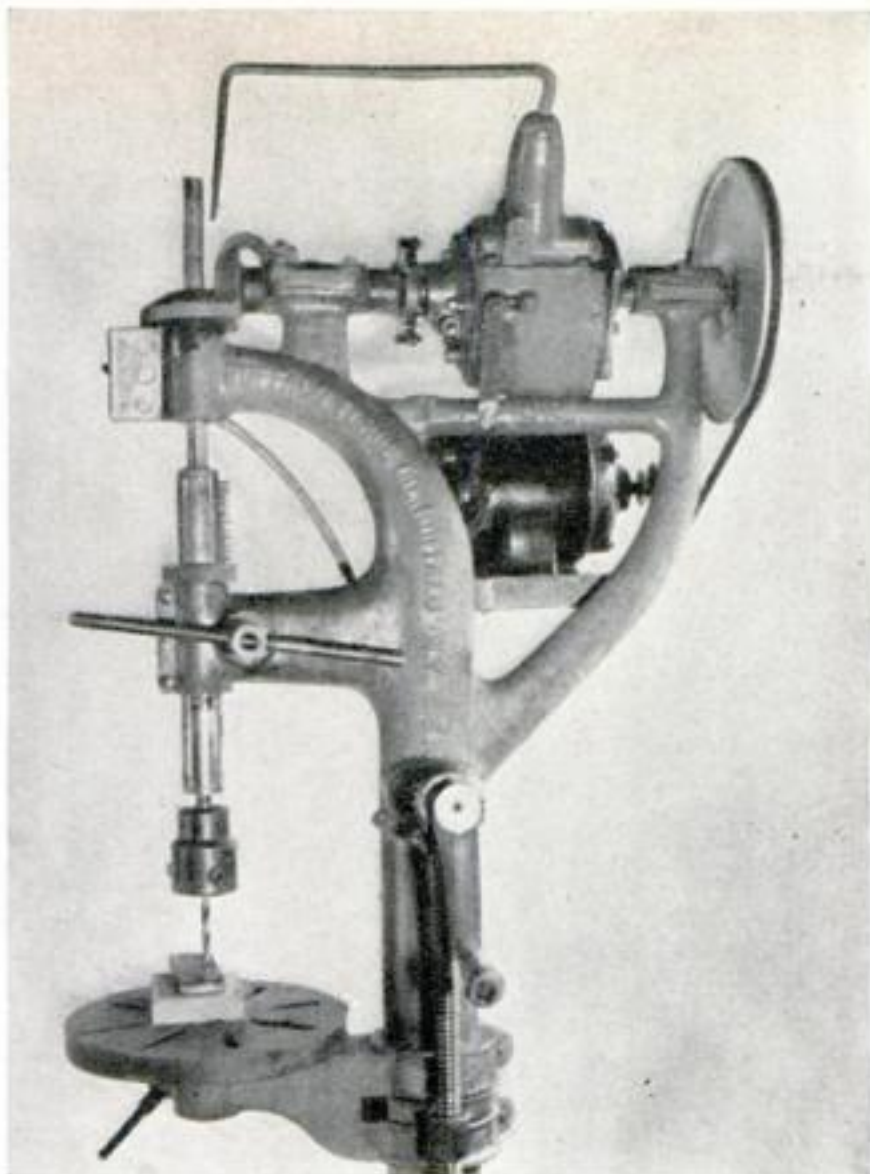
Small cutters may be used on the spindle for undercutting motor commutators. A small truing diamond is also shown in the photograph referred to (Fig. 1), and it will be found a necessity where grinding wheels are to be used for precision work.

A grinding-wheel guard is highly desirable at all times, but especially for use with larger wheels. A drawing on the preceding page shows a simple but serviceable one that may be made of cast iron and mounted directly upon the quill housing.

The operator should never neglect to wear safety goggles when using any grinder, nor under any circumstances should he drive grinding wheels at higher speeds than the manufacturers recommend.







## Old Auto Transmission Gives Drill Press Flexibility

ON MANY types of drill presses it is possible to install an automobile transmission to give an additional range of speeds and facilitate changing from one speed to another. The press may also be run in reverse, which is useful in tapping.

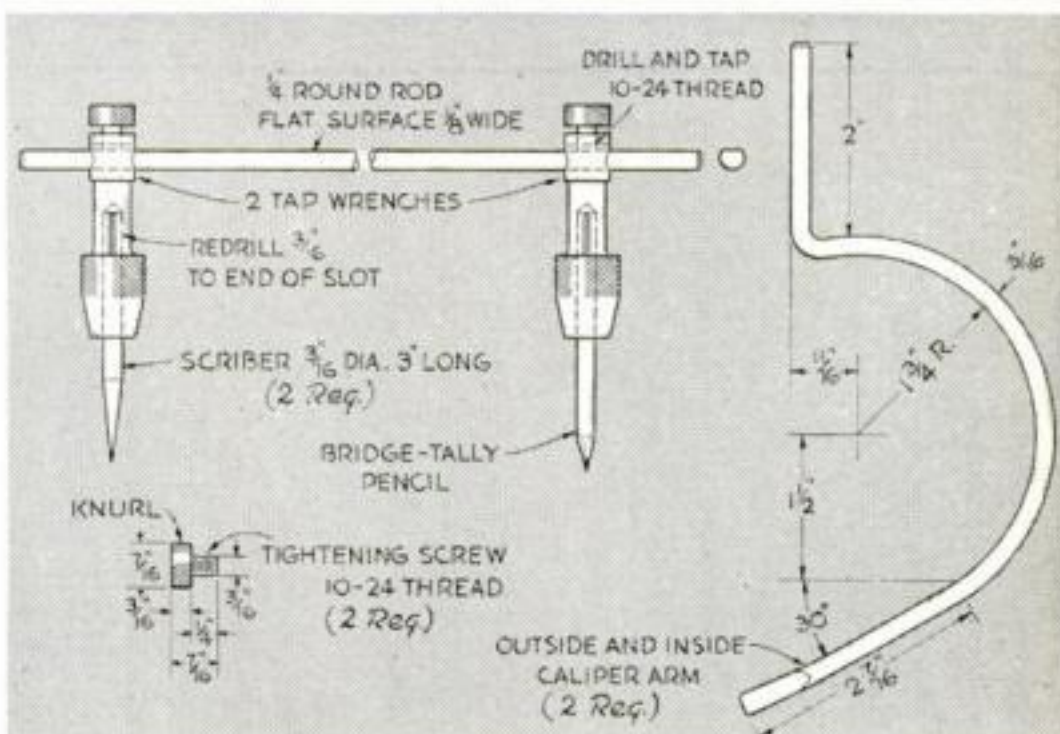
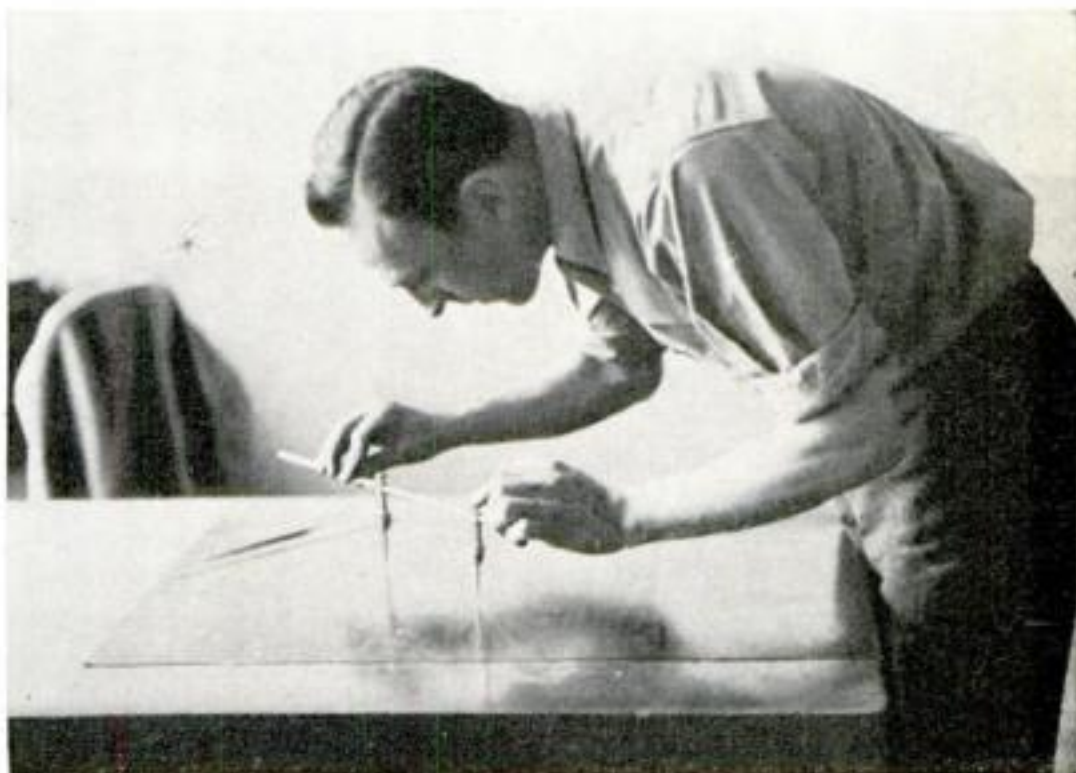
If the press is like the one shown, first remove the cone pulley from the top, cut off the shaft, and mount a flange on the shaft to fit the regular universal-joint flange that is found on open drive-shaft transmissions. Then grind down the splined shaft to fit the drill-press bearing. The transmission is mounted on the drill-press frame as illustrated. To keep it from rotating, it is held by a brace, bolted to both itself and the frame. The transmission is driven by a V-pulley belted to a cone pulley on the shaft of a  $\frac{1}{2}$ -h. p. motor. Speed ratios are changed by sliding the motor endwise. The gear-shift lever is bent to suit. A motorcycle transmission can be used if reversing is not essential.—FRANK VAN DUZER.

## Combination Trammels Made from Inexpensive T-Type Tap Wrenches

THE trammels illustrated combine both a beam compass and inside-outside bar calipers. Two ordinary ten-cent T-type tap wrenches are altered as shown for the adjustable parts, and the beam is a  $\frac{1}{4}$ " round steel rod of any length desired.

File or grind a flat surface  $\frac{1}{8}$ " wide along the entire beam for the knurled set screws to engage. The set screws are turned and threaded as indicated, and a corresponding hole is drilled and tapped in the top of each tap wrench.

The center point and scriber as well as the pair of caliper arms are made of  $\frac{3}{16}$ " round steel rod. File or grind short pieces sharp to make the center point and scriber. Bend two longer pieces to shape as shown in the drawing to form the caliper arms. A bridge-tally pencil is substituted for one of the points when the tool is to be used as a compass.—S. N. SKAY.





# How a Plane Flies

## HOME TESTS ILLUSTRATE PRINCIPLES OF AVIATION

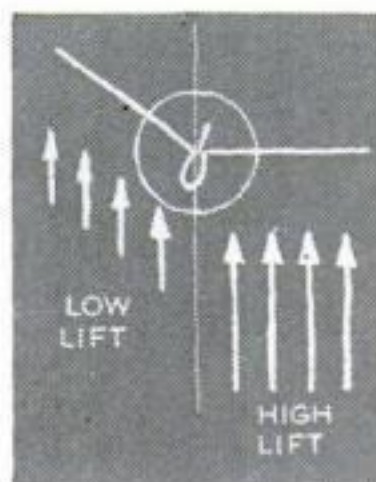
**F**IVE EASY do-it-yourself experiments, on these pages, should tell you more than hours of reading about how airplanes and their instruments work. Try the tests and you will understand many of the basic ideas that designers currently are building into thousands of aircraft.

Did you know that the wings of many planes are set at an angle to each other?

The first experiment below shows how the arrangement helps a plane to "fly itself." You may never have noticed the V design, because it slants only one to four degrees from the horizontal. A greater angle would make the plane *too* stable—that is, "stiff" and hard to manage. At the other extreme, fast fighting planes have low stability, to aid maneuvering.

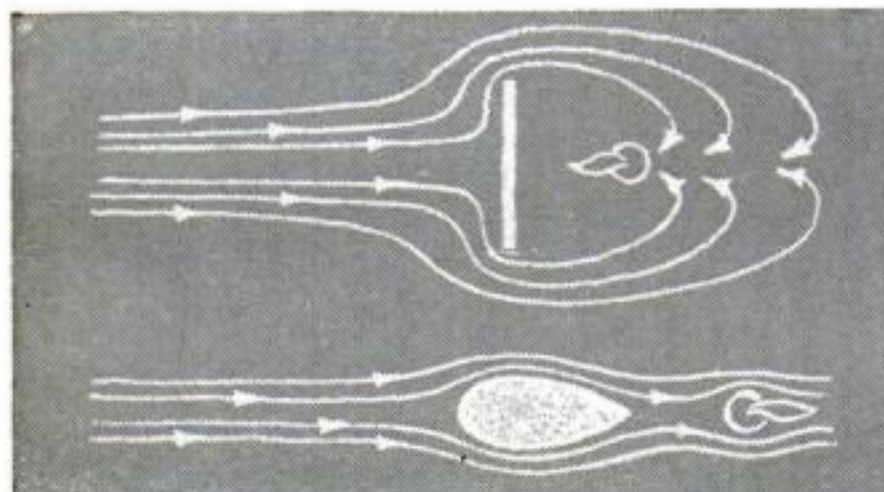


**"V" WINGS AID STABILITY.** Cut two toy airplanes, just alike, from stiff paper. Crease one lengthwise as shown. Dropped, it falls right side up, while the flat one sideslips and

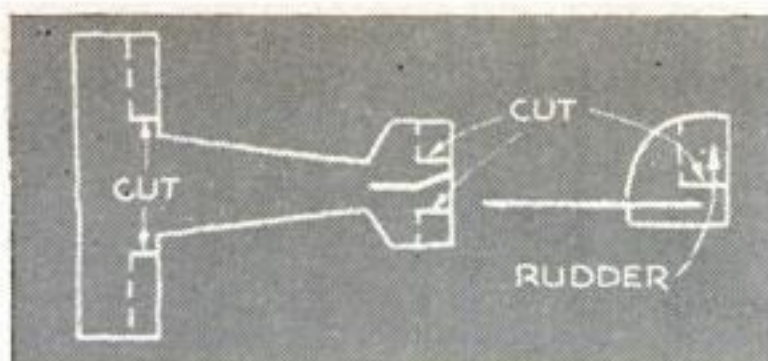


turns over. This V shape, or "dihedral," makes real planes self-righting, because the upper wing loses lift and the lower wing gains lift if the craft tips sideward. Pilots are relieved of constant use of controls, and consequent fatigue on long flights.

**WHY PLANES ARE STREAMLINED.** Blow against a flat card, held in front of a lighted candle. Surprisingly, the flame will be drawn toward the card. This indicates a "drag" or low-pressure air pocket behind the card. Now bend a piece of cardboard to tear-drop shape, and repeat the test. This time the candle flame will be pushed away by the air stream. Also, pressure that can be felt against the flat card is absent in the second experiment. Since the streamline shape diminishes pressure in front and suctional drag in back, allowing air to flow in a smooth stream past it, this design is used in aeronautics to offer the least air resistance.



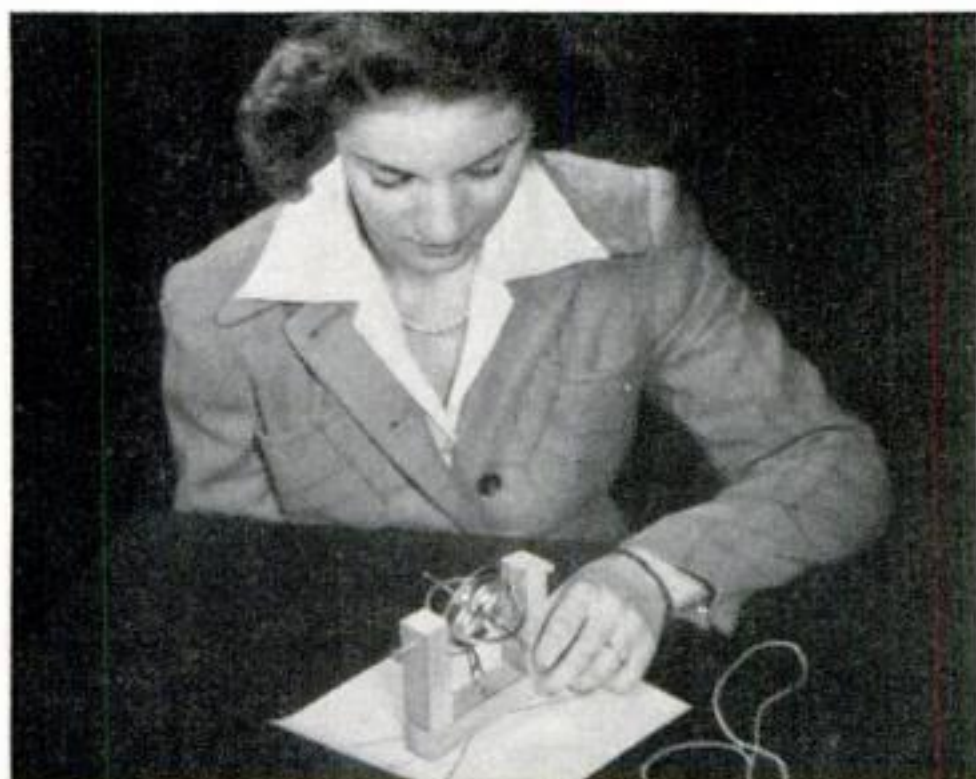




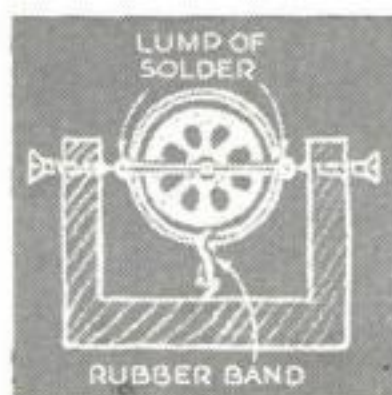
**HOMEMADE WIND TUNNEL.** To study how control surfaces make a plane climb, dive, turn, and bank, mount a cardboard cut-out on two vertical guide wires. Pass these through holes in the wings, so that the plane can slide freely up and down. A small brad, representing an engine, may be taped on and adjusted to balance the model. Then place it in front of an electric fan, fitted with an "egg-box" attachment of cardboard to straighten the air stream. Bending the ailer-



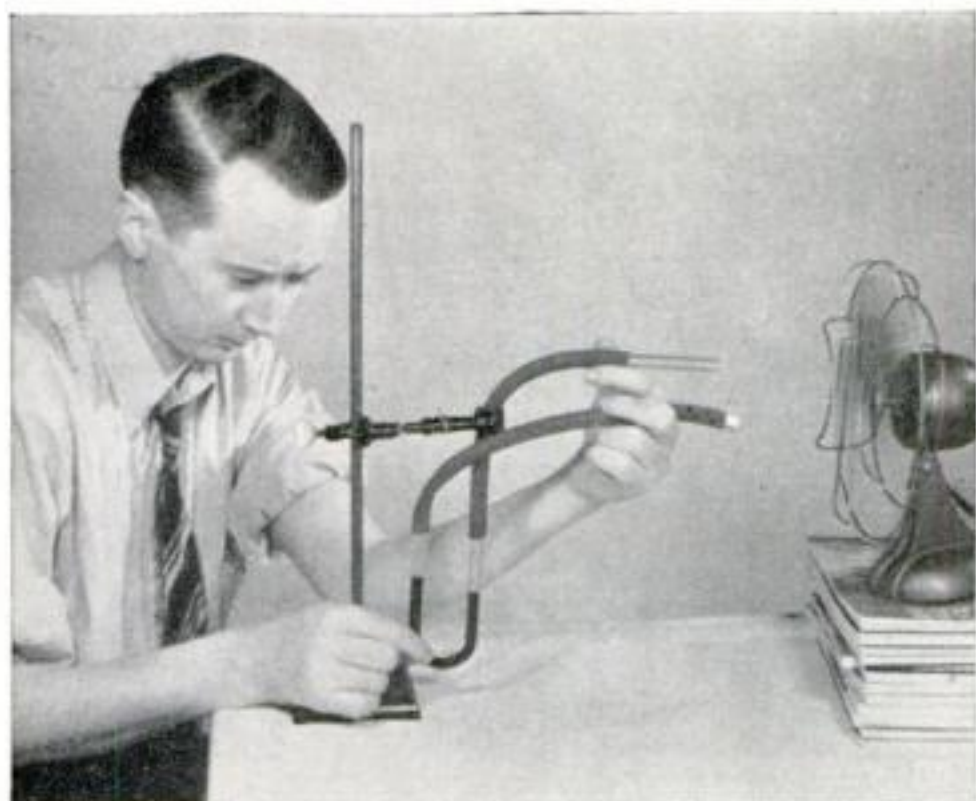
ons, elevators, or rudder will put the model through its various paces. If the elevator fins are set to make the model climb too steeply, it will stall and drop like a real plane.



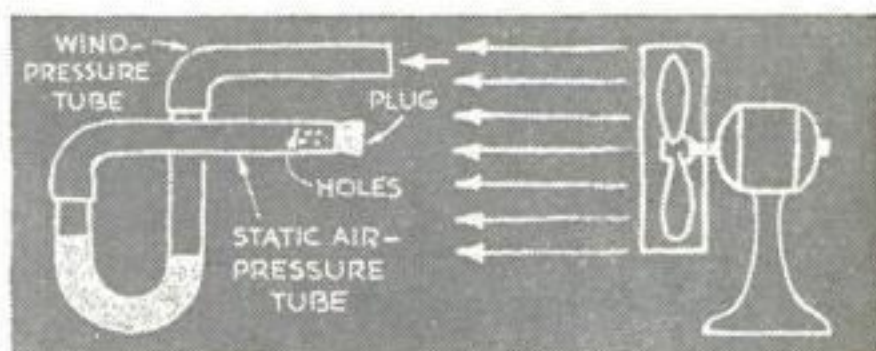
**TURN INDICATOR.** A toy gyroscope will illustrate the principle of the instrument that tells a blind-flyer when he is turning. Mount it in a wooden frame as shown. Small lumps of solder, dented at the center, serve as bearings to let the gyroscope swing freely. Set its wheel spinning rapidly in the same plane as the frame. Now turn the frame to



left or right, and the gyro will tilt one way or the other. When you stop turning the frame, a rubber band brings the gyro back to normal position. In an airplane, an indicator attached to the gyro mounting gives a reading on a dial.



**AIR-SPEED INDICATOR.** Make a glass tube as illustrated, with a dozen or so small perforations near one end. Close this end with a plug, and partly fill the tube with colored water. Point both the open and closed ends at an electric fan, and note the change of level of the liquid, which serves to measure the speed of the air stream.





# Radio Ideas

**A STORAGE BATTERY**, instead of the conventional dry-cell type, is used in a new portable radio to eliminate the bother and expense of replacement of the power-supply units. Included in the set is an automatic charger with which the battery may be recharged from a 110-volt A. C. line or from an automobile-type six-volt storage battery, while the set is in operation or when it is turned off. The battery lasts from 15 to 20 hours without recharging and is non-spillable. Automatic charge in-



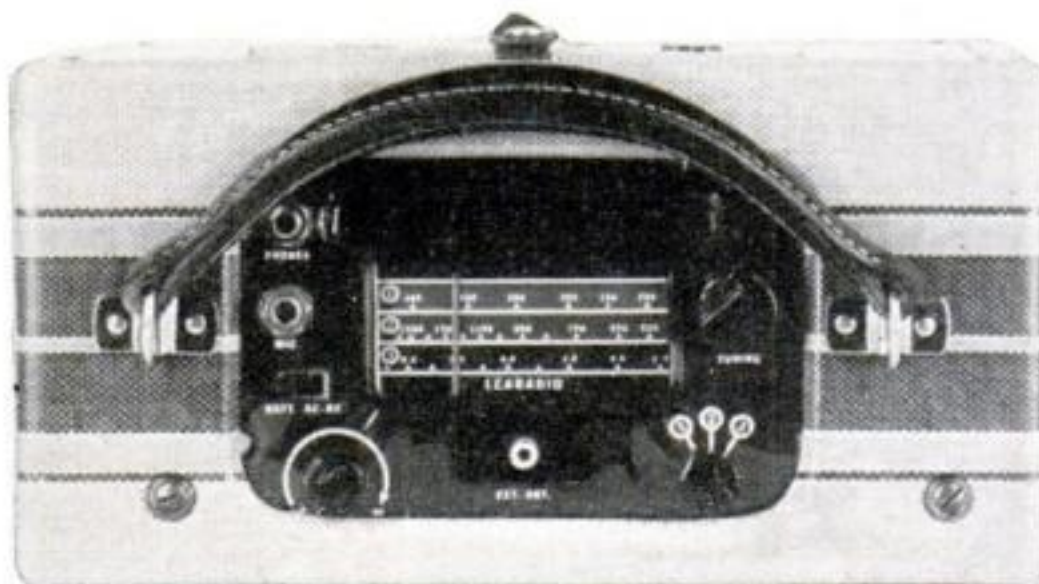
A. C. may be used both to recharge the battery of this portable set and also to bring in programs

**LIGHTNING ARRESTER** and line-voltage regulator are combined in a simple unit which is inserted between a radio-set power cable and the electric outlet. Costing only \$1, it provides valuable protection, particularly in areas where overhead power lines are apt to pick up heavy induced charges during electrical storms which might damage an unprotected set. At the same time it maintains voltages reaching the set within safe and satisfactory limits for good reception.

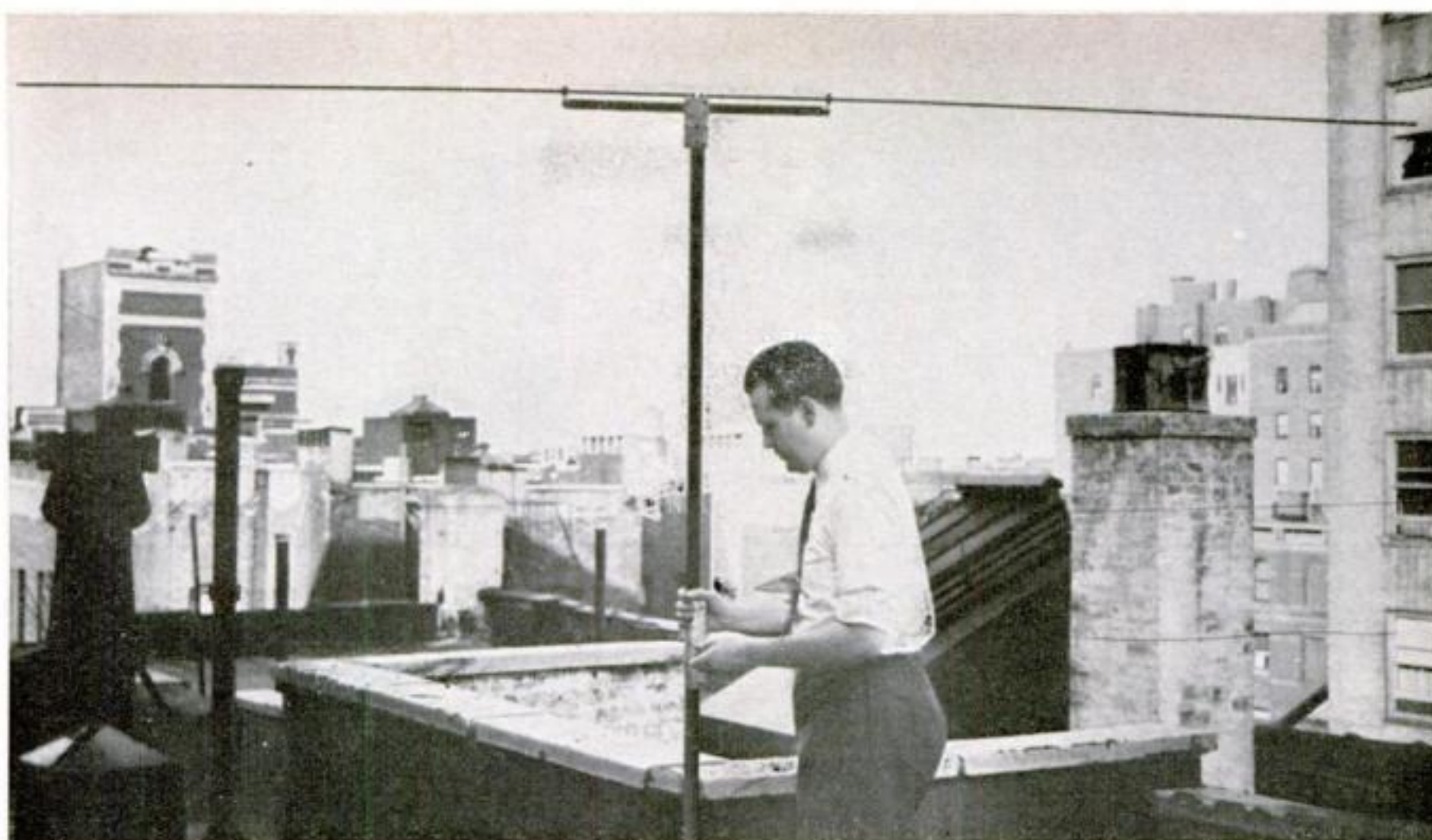


Complete pick-up of aeronautical as well as standard broadcasts is possible with this set, plus interphone use in a plane

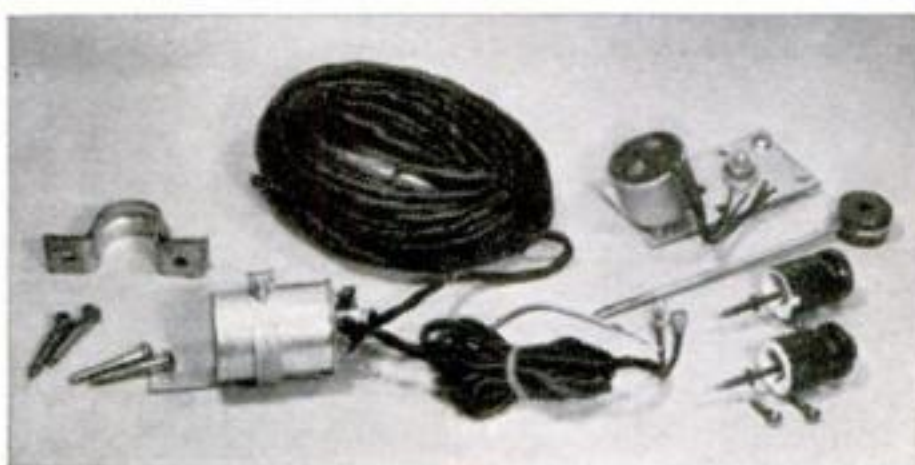
**FOR USE IN PLANES** as well as on the ground, this portable set provides complete coverage of two important aeronautical bands in addition to the standard broadcast band (540-1,560 kilocycles). They are 195-410 kc., which covers radio ranges, weather reports and traffic control, and 2,200-6,300 kc., airway communications, Coast Guard, Army, and Navy aeronautical frequencies. It may be operated on A.C. or D.C. lines or its own batteries. It can be used also as an interphone for talk inside a plane.







**COMBINATION ANTENNA.** Here is a single antenna system designed to meet the diverse requirements of AM, FM, short-wave, and television reception. It is made possible by the use of an ingenious selector transformer with an ultra-high frequency iron core for maximum transfer of radio energy. In its simplest form, the system consists of a dipole, two metal rods held by a center bracket and mounted on top of a mast. These are connected to the transformer, also mounted on the mast, which feeds into a transmission line. This may exceed 100 feet in length, making it possible to place the dipole where maximum signal pick-up can be obtained without excessive interference. Where signals are weak, a reflector, consisting of



An ingenious selector transformer lets this simple antenna serve F. M., A. M., short waves, and television

a second dipole mounted a quarter wave length behind and parallel to the first, can be mounted on a cross bracket. Other variations permit adaptation of the system to individual installation problems.

**COMPACT COILS.** Made especially for use on the airways band of 195-410 kilocycles, these midget coils complete with shield cans are only  $1\frac{1}{2}$  inches in diameter and  $1\frac{3}{4}$  inches high. Their windings are thoroughly impregnated for protection against all

changes due to variations of temperature and humidity. The antenna coil has a "tertiary" winding serving as a low-impedance primary for use with a loop or other type of aircraft antenna, and a normal high-impedance primary is provided for use with the customary antenna-ground circuit. The coils are designed for use with a 365-mmfd. tuning condenser, and an adjustable padder must be used with the oscillator coil. Although they were designed for aircraft use, these coils are useful for adding a "long-wave" band to almost any receiver with a 365-mmfd. tuning condenser.







The twin phonographs and amplifier are installed in a 26" suitcase, the speaker in a matching hatbox

## INEXPENSIVE DUAL-TURNTABLE PHONOGRAPH

**Portable and Easy to Build, It  
Provides Sound Accompaniment  
for Your Own Home-Movie Films**

By ARTHUR C. MILLER

**A**LL SORTS of entertainment possibilities are opened with this easily built twin-table phonograph. If you are a music lover, it will allow continuous reproduction of your favorite symphonies and operas. If you like nonstop music for dancing, it will supply that. And if your hobby is home movies, it can be used to provide realistic fade-in and fade-out accompaniments and sound effects for your favorite films. Complete and housed in two pieces of luggage for easy carrying, the outfit can be built for \$35.

The containers for the equipment consist of a standard 26" week-end bag and a standard hatbox, matching in color and design. Into the larger bag go the two self-starting, A.C. motors with 9" turntables,

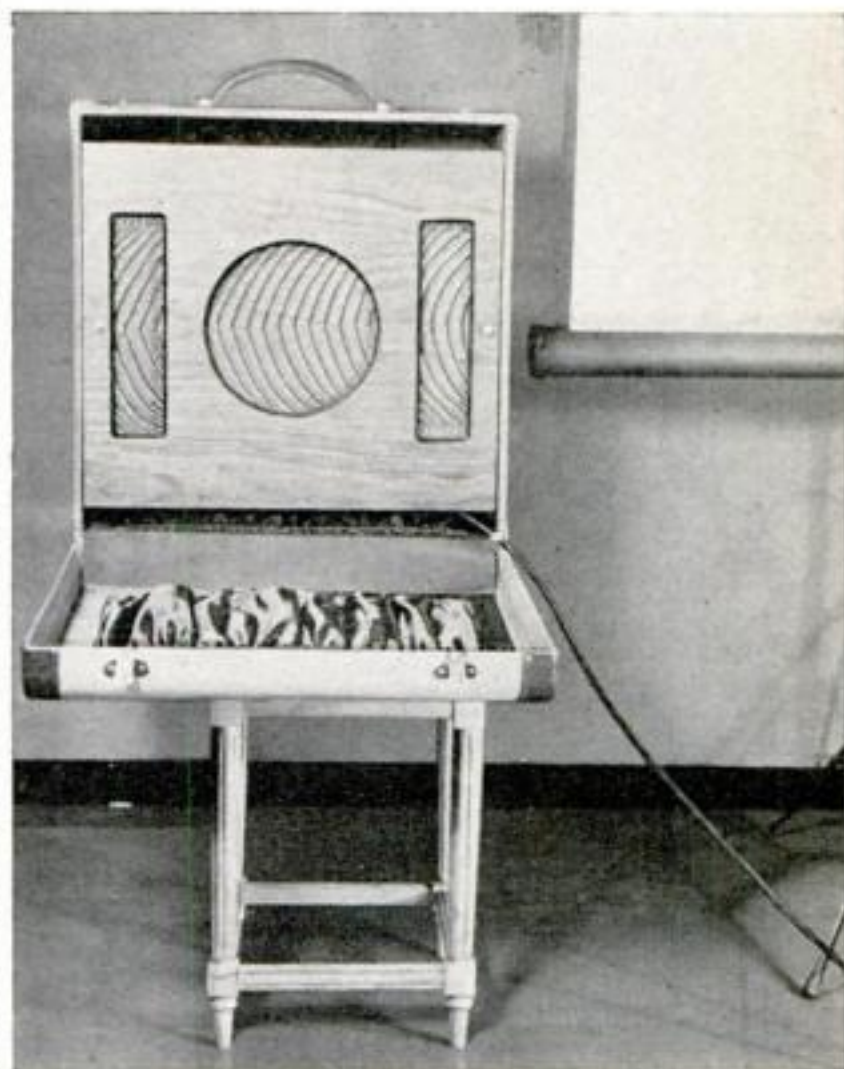


Close-up of the motor panel showing the two turntables and pick-up arms, and the tone and fader controls. The switches next to the turntables operate the phone motors. While one unit plays music, the other may provide the incidental sounds





How the two units are set up for use. The phonographs are beside the movie projector where the operator can put on and change records and regulate the volume. The speaker unit, connected by a 25' cable, is placed near the screen



two crystal pick-ups, and the 4-watt amplifier system with fader and tone control. In the hatbox is the 8" permanent-magnet speaker, provided with a 25' length of heavy, rubber-covered cable so that the speaker can be placed beside a movie screen. At one end of the table is a microphone-type plug which fits into the jack at the motor panel.

On the motor panel, which is a  $\frac{1}{2}$ " by  $15\frac{1}{8}$ " by  $24\frac{7}{8}$ " sheet of plywood, are mounted two S.P.S.T. toggle switches for starting or stopping the two phonograph motors. The motors should maintain a constant speed of 78 revolutions per minute at all times. Those used by the author have large bearings and laminated-bakelite helical-cut gears completely inclosed and protected.

Above the three-tube amplifier is an opening  $3\frac{1}{2}$ " by 10" and protected by a piece of cane sheeting  $4\frac{1}{2}$ " by 11". The cane sheeting may be obtained at any large hardware store. It should have a coating of black enamel paint to prevent rust and enhance the general appearance of the equipment.

On a small black-crackle aluminum panel,  $2\frac{1}{2}$ " by 6", are mounted the two fader controls regulating the output of each pick-up, the tone control, and the amplifier on-and-off switch which is mounted on the 250,000-ohm tone control.

The fader controls are two 100,000-ohm

variable resistors connected in series between the control grid of the input triode and ground. Across these is a 1-meg., 1-watt carbon resistor.

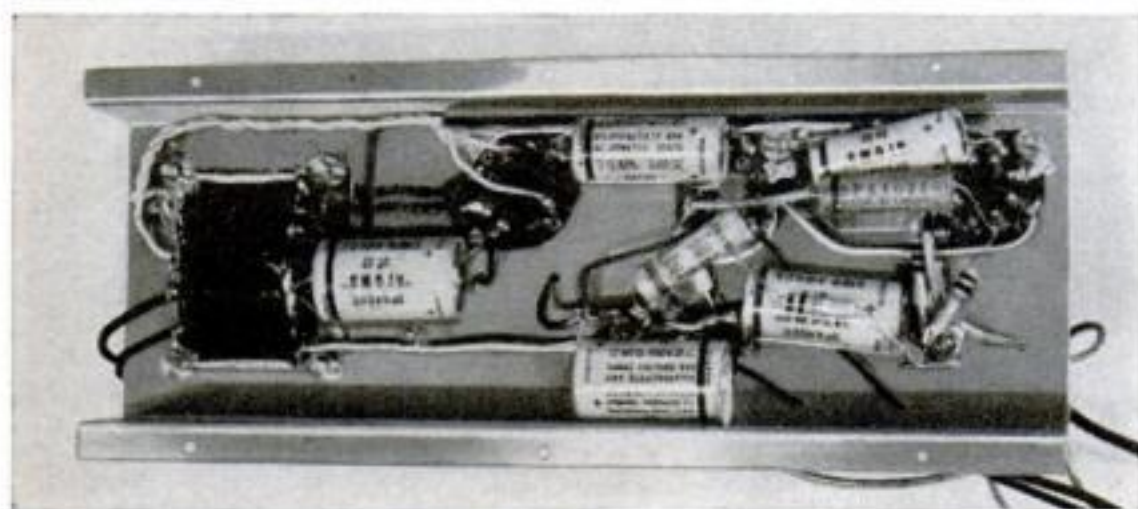
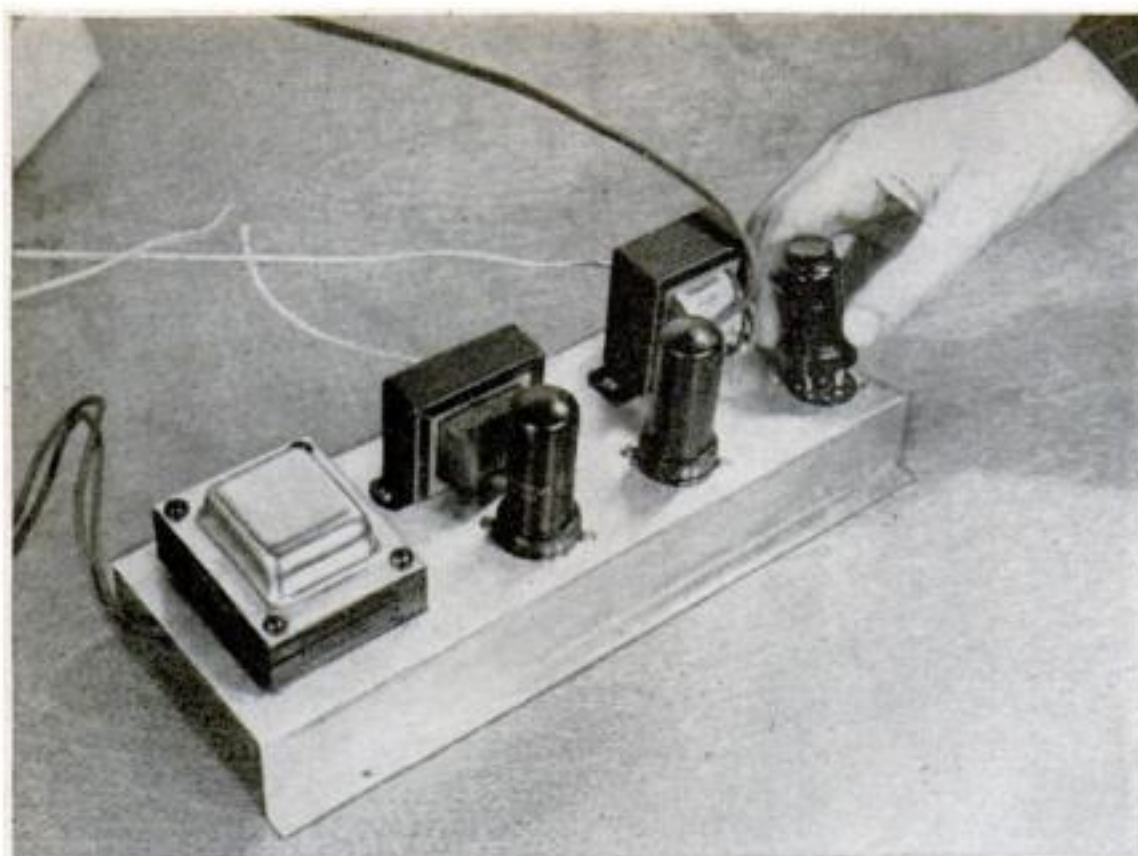
The 6C5 is resistance-coupled to the 6F6 pentode by means of the 50,000-ohm, 1-watt resistor, the .1-mfd. coupling condenser, and the 500,000-ohm, 1-watt grid resistor. Amplification is ample with the crystal pick-ups used to operate the 6F6 at its maximum output of  $3\frac{1}{2}$  to 4 watts.

The power transformer has three secondary windings—300+300 volts at 60 milliamperes, 5 volts at 2 amperes, and 6.3 volts at 2.5 amperes. A 30-henrys choke, rated to pass 75 milliamperes, and two 12-mfd. electrolytic condensers constitute the filtering circuit. A 10,000-ohm, 1-watt resistor in the plate circuit of the 6C5 and by-passed by an 8-mfd. electrolytic condenser stabilizes the amplifier and prevents feed-back.

A high-mu triode (the 6F5) may be substituted for the 6C5 if greater volume is desired. However, the output of this amplifier, with the 6C5, is ample even for a small dance hall. If needle scratch is noticeable, an inexpensive scratch filter may be connected in the output of each pick-up unit. The filters can be mounted beside the motors under the motor panel.

Instantaneous changing of the records is





Top and bottom views of the amplifier chassis which should be bolted to the bottom of the suitcase under the motor-panel grill. Metal tubes are used—an important advantage in portable units

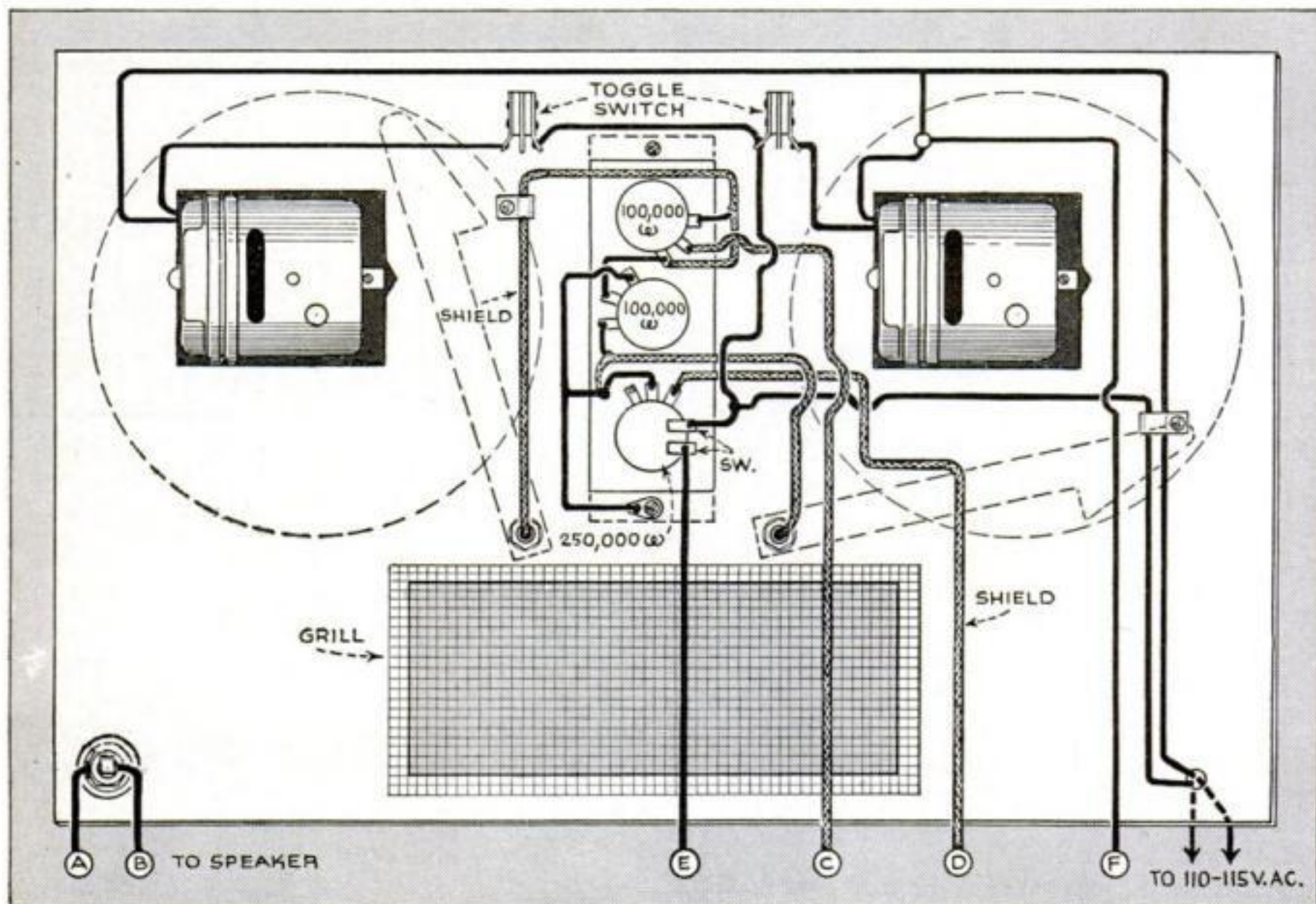
possible with the twin pick-up units, one record being readied while another is playing. For home-movie work, records or parts of them can be faded in or out at will. And, if desired, a sound-effects recording may be played simultaneously with an instrumental recording.

Ilya Laskoff, composer and conductor for the Columbia Broadcasting Company, suggests the following records for use with home-movie scenes:

For ocean scenes, Debussy's "La Mer" and Mendelssohn's "Fingal's Cave." For western scenery, Ferde Grofe's "Grand Canyon Suite" and "The Plains" by Bernard Rogers. For pictures of children, Debussy's "Children's Corner." For country scenes, "Pastoral Symphony" by Beethoven.

For industrial scenes of ship-yards, railroad terminals, or factories, Mr. Laskoff's choice is either "Ironworks" by Mos-solow, or "Steel Mills" by Ferde Grofe.

Pictorial diagram of parts under the motor panel. Needle-scratch filters may be added if necessary





## LIST OF PARTS

Power transformer, 600 volt, 50 ma.; 5 volt, 2 amp; 6.3 volt, 2½ amp.

Filter choke, 30 henrys, 400 ohm.

Universal output transformer.

Tubes, 6C5, 6F6, and 5W4.

Crystal pick-ups (2).

Phonograph motors (2) with 9" turntables.

P.M. speaker, 8".

Suitcase (26" size).

Hatbox.

Chassis, 1½" by 4" by 12".

Octal wafer sockets (3).

Shielded hook-up wire.

S.P.S.T. toggle switches (2).

Volume controls, 100,000 ohm (2).

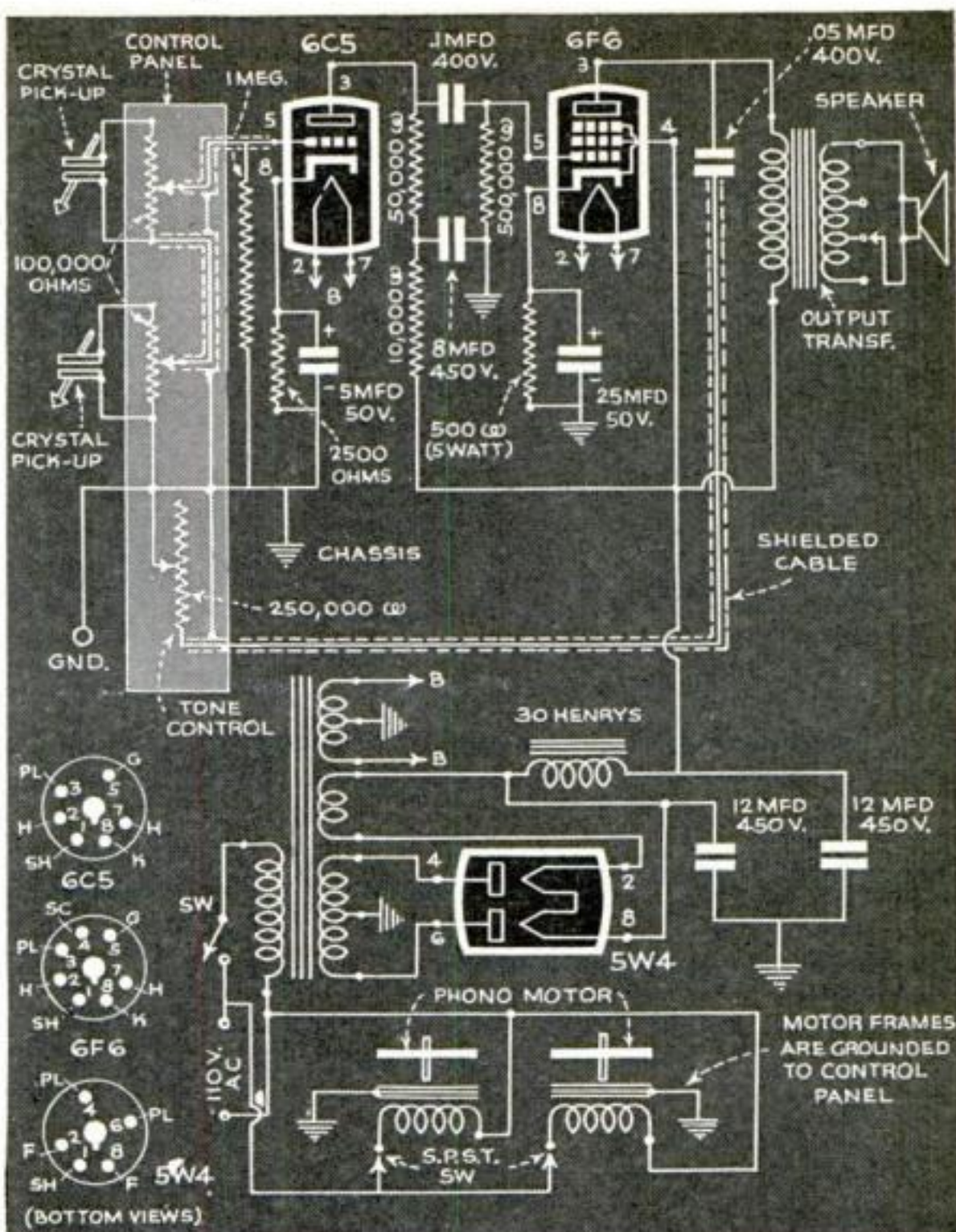
Tone control, 250,000 ohm.

S.P.S.T.-switch cover plate (for above).

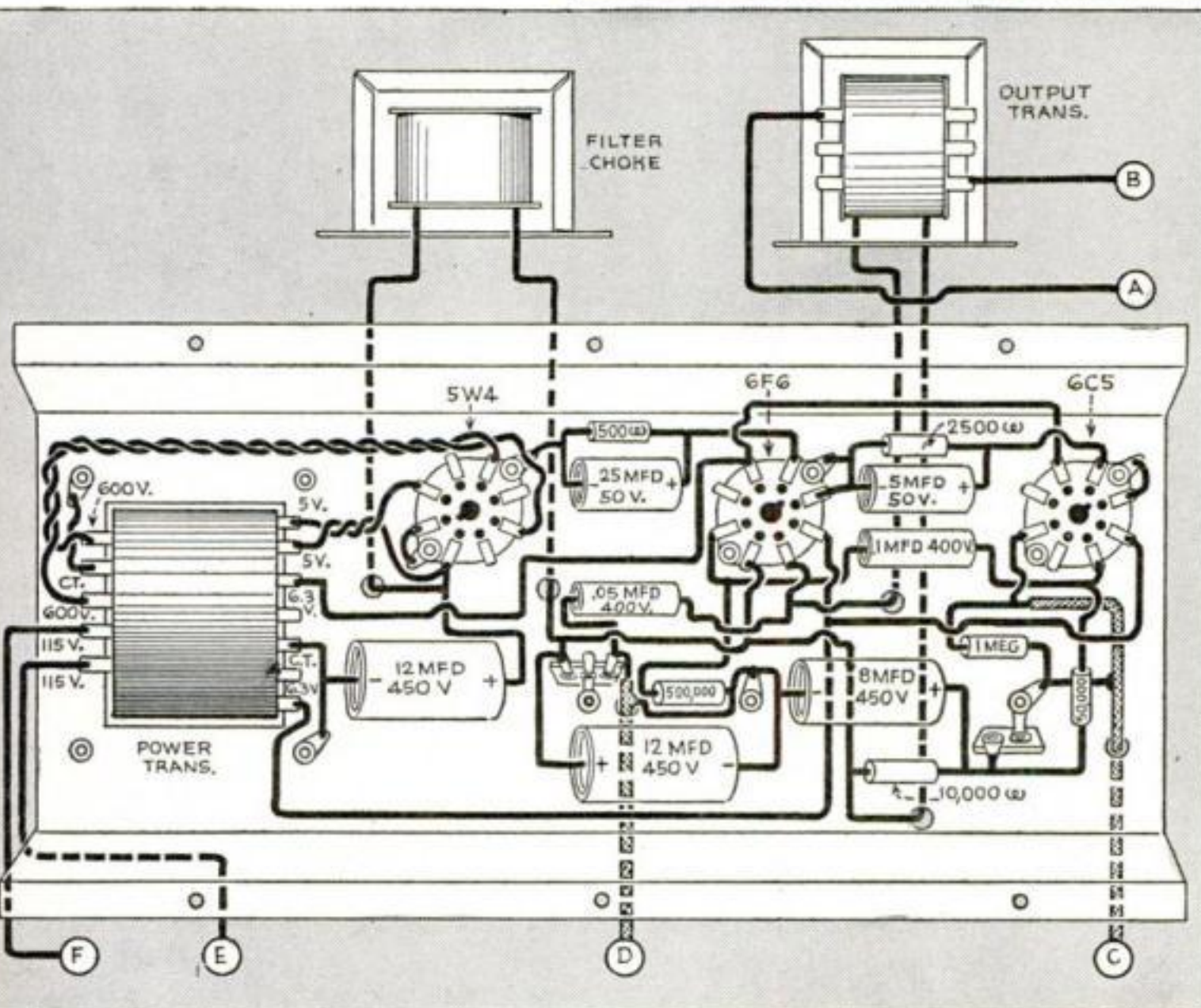
Electrolytic condensers, 12 mfd., 450 volts (2); 25 mfd., 50 volt; 5 mfd., 50 volt; and 8 mfd., 450 volt.

Tubular condensers, .05 mfd., 400 volt, and .1 mfd., 400 volt.

Carbon resistors, 500 ohm, 5 watt; 2,500 ohm, 1 watt; 10,000 ohm, 1 watt; 50,000 ohm, 1 watt; 500,000 ohm, 1 watt; and 1 meg., 1 watt.

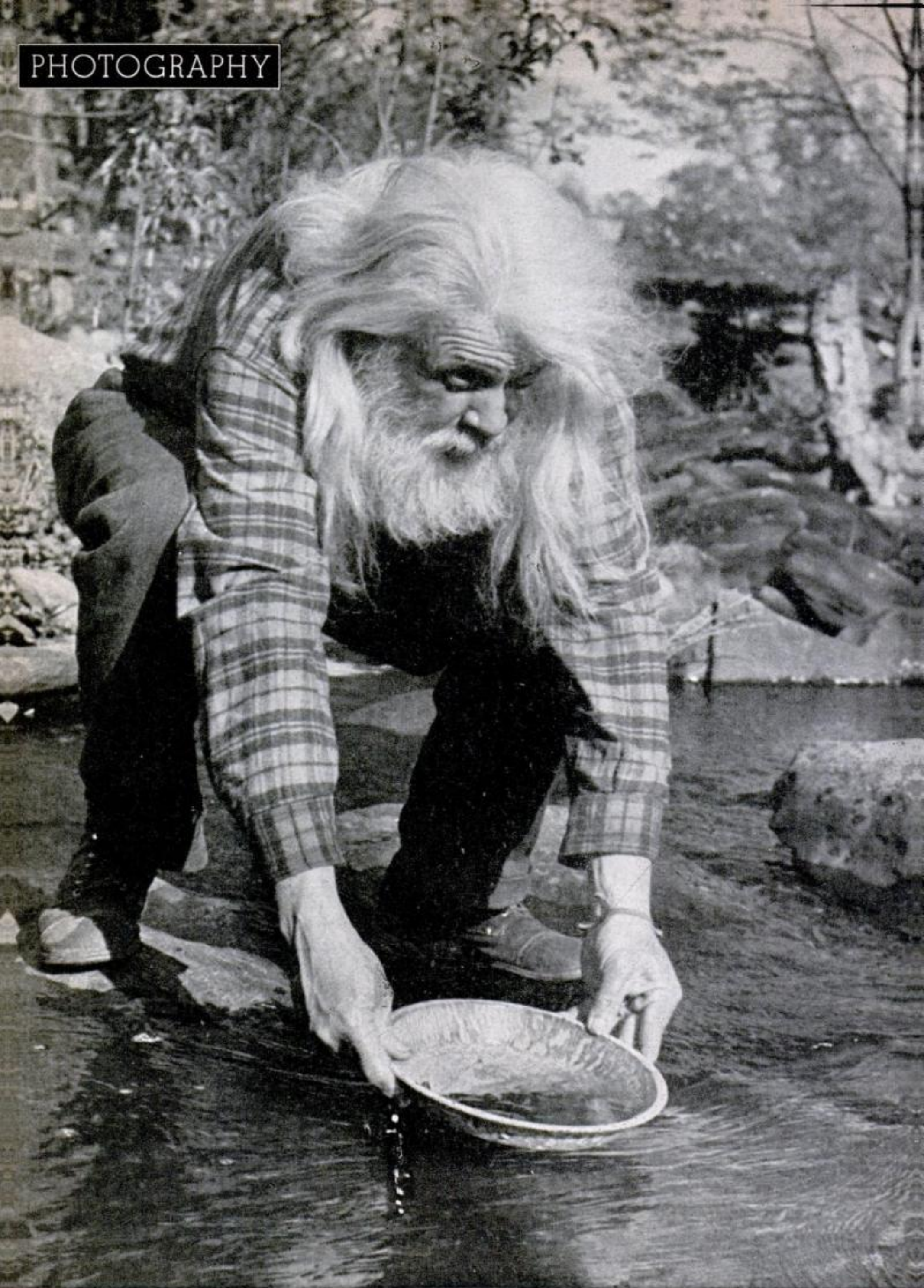


Above is a complete wiring diagram for the amplifier and loudspeaker circuit. The motor frames are grounded to the control panel



In this pictorial diagram, the placing of the parts of the amplifier circuit above and below its chassis are shown in detail. In making all connections, use solder







# CAMERA BUS

By MABEL SCACHERI

Photo Columnist and Co-Author of "The Fun of Photography"

SUMMER is no time for camera clubs to be sitting indoors listening to the usual solemn lectures on gamma, radial composition, or the time lag in a flash bulb. Yet the club does not need to fold up completely, as most of them do for the warm-weather months. The shutterbugs can charter a bus and swarm out upon the countryside for a day's outing far more interesting than the usual aimless ramble by car.

The first consideration, of course, is "How much?" Bus rates vary, so it pays to shop around. Some companies make a flat rate; some charge by the mile—usually about 25 cents if no more than 22 people ride, or 40 cents if there are more.

A club can save money by picking up the

camera-trippers at some one's house, or in front of a school or other public building, saving the fee usually charged for use of the bus terminal. If your club is too large for one bus, yet won't fill two, you have to pay for those empty seats unless you do a good job of ballyhoo and sell them to camera-minded friends, or even to people who just want the ride. There are always a certain number of these to be found—sometimes elderly people unable to drive a car; sometimes strangers at a hotel more than ready for an interesting Sunday trip.

Well in advance of chartering the bus, the best pictorialists in the club should scout around by car and plot the course. Aimless wandering will not bring you to the best

Left, panning gold—in northern New Jersey! This shot of a bewhiskered professional model was made by Jay Florian Mitchell, well-known New York commercial photographer and teacher, but bus-minded camera fans do not need to depend on professionals when some of their own photogenic members can pose. Below, shutterbugs are not too tired on the way home to join in singing "A Long, Long Trail"





locations unless your part of the country is exceptionally rich in scenic beauty. Even then, these spots are at their photographic best at certain times of the day, and the trip should be planned to arrive when the light is best.

A trip usually goes like this: Starting time, about 9 a.m. They are always a little late starting, because Joe phoned he had to fix a leak in the bathroom plumbing, or he forgot to buy film. (Don't let anybody get away with that alibi. And take along a good supply of extra film. Somebody always needs more.)

**T**HE morning is used up in getting out of town and into the fine scenery, the farms, the hills. About noon you stop for lunch. Bring it along with you. It saves an hour or two, since a restaurant stop for a large group is bound to slow things up. The club can appoint a commissariat to buy bread, soft cheese, ham, jam, cakes, and fruit, or each member can bring his own provender. In either case, make it simple. No steak broils or "weenie" roasts, unless you want to plan one for about 7 p.m., on the way home. The dinner stop, at some good restaurant which has been warned of your coming, may be an interesting detail. Haphazard dinner stops are almost always disappointing.

The idea of the lunch is to get it over with quickly, for now you are in the scenic country, near your goal, and pretty soon the light will be getting gorgeous for picture-taking. From 3 to 6 p.m. are the real photographing hours, and it takes an hour or so to get set.

The pictures need not be catch-as-catch-can shots, and the beginners can be given a lot of help by the more advanced members. For instance, on one such expedition, the photographers found a very photogenic waitress at a small restaurant. She posed for head studies. The sun was too bright for good portrait lighting, as it made the shadows too deep. The thing to do was to reflect some light from a white surface into those shadows by holding up a handkerchief, a newspaper, or a chromium ferrotyping tin.

Wherever you stop for pictures, it is good politics to ask permission of the owner before you swarm over his ground. He usually has no objection, but he may not want you to cross a certain field, or he can advise you against climbing into the "medder" where he keeps the bull, or the tree where the wild bees hang out. He may also know of pretty little spots that you would not find. Not only that, but he and his family may be photographic themselves, and get a kick posing for the shutterbugs.

Don't depend on those lucky breaks. Take along your models. They need not be professional, paid models. A pretty girl, a cute kid, an old man with an interesting face, a young couple full of good looks and animation—these add greatly to your photographs. A scene with no human figure has to be mighty good, and must be handled extremely well, to make a good photograph. But a pleasant little spot, with a handsome couple sauntering through or children climbing a fence, always works up easily into an interesting shot, well within the imagination of casual, bus-tripping fans. The gang does not want to think too hard, you know—not on a pleasure jaunt.

See that the models are dressed photographically. The kids in straw hats, plaid shirts, and overalls, for instance; the young couple in smart outing togs, or the lady in a fluffy summer dress. Striped material photographs well. An old chap with white hair may work up well as a farmer. Dress him according to character.

One bus tour in the East takes along professional models, but only because it is easier. One of the models, Edward Grace, a retired actor, looks more like a farmer than most farmers do. Another, Bob Evans, has white Santa Claus hair and beard. As a miner, he will pan gold; as a bum, sleep under a tree. Each fan poses him according to his own ideas.

**A**LTHOUGH it pays to take along models, you often do pick up some good shots from casual encounters. The owner of the restaurant, where one camera bus made a coffee stop, owned a stuffed snake. He said, "Wouldn't it look funny if I got down on the grass with this snake on my chest, and posed as though I had waked up and found him there!" It looked funny, all right, and the fans got a humorous shot.

If some farmer has an exceptionally scenic farm, maybe it will be best to concentrate on that one place, and shoot farm pictures. In case you do that, keep in mind the farmer's troubles. If you pull up on fence wires, you loosen the fence, and he has a mean job of going around and tightening afterwards. If you leave the gates open, the cattle get out and have to be chased home.

The bus companies usually send along a good-natured driver who falls in with the spirit of the occasion. One driver led some of the singing on the way home. Incidentally, if you can take along somebody gifted with an accordion, ukelele, or mouth organ, it adds to the gayety of the trip home.

It is perhaps unnecessary to say that these trips are more fun if they are co-ed. Women enjoy such outings, which help sell the wife or girl friend on photography as a hobby.





Lunch must be eaten on the camera-bus trip, but be brief—sandwiches, doughnuts, fruit, coffee from a wayside stand. Then, on the way to look for picture material

A gate and a tree on a hill. Not bad, but improved ever so much by the two climbing boys, sons of Mr. Mitchell, who directed the bus tour described by Mrs. Scacheri



Some real instruction goes along, too. The bus driver helps out by holding a white handkerchief to supply reflected light for filling in shadows in a portrait shot



Occasionally a good model is picked up along the way. This one, a restaurant owner, had a stuffed snake, and even suggested the pose



Shutterbugs get in line for the long shots, always one of the attractions to be sought on a well rounded-out camera-bus trip. All in the party get an even break, with some kneeling and some standing





Plain, ordinary daylight was good enough for N. C. Ehlke, of Rhinelander, Wisc., when he took this appealing picture of his son, but he had to shoot unusually fast—at 1/300 second—or the wind would have given a blurred effect to the fur in the cap

## Prize Portrait

### OUTDOOR SHOT WINS \$25 IN PHOTO CONTEST

A PORTRAIT of his son taken outdoors on a hazy day won for N. C. Ehlke, of Rhinelander, Wisc., the prize of \$25 offered by POPULAR SCIENCE for the best portrait photograph submitted by a reader (see P.S.M., May '41, p. 214).

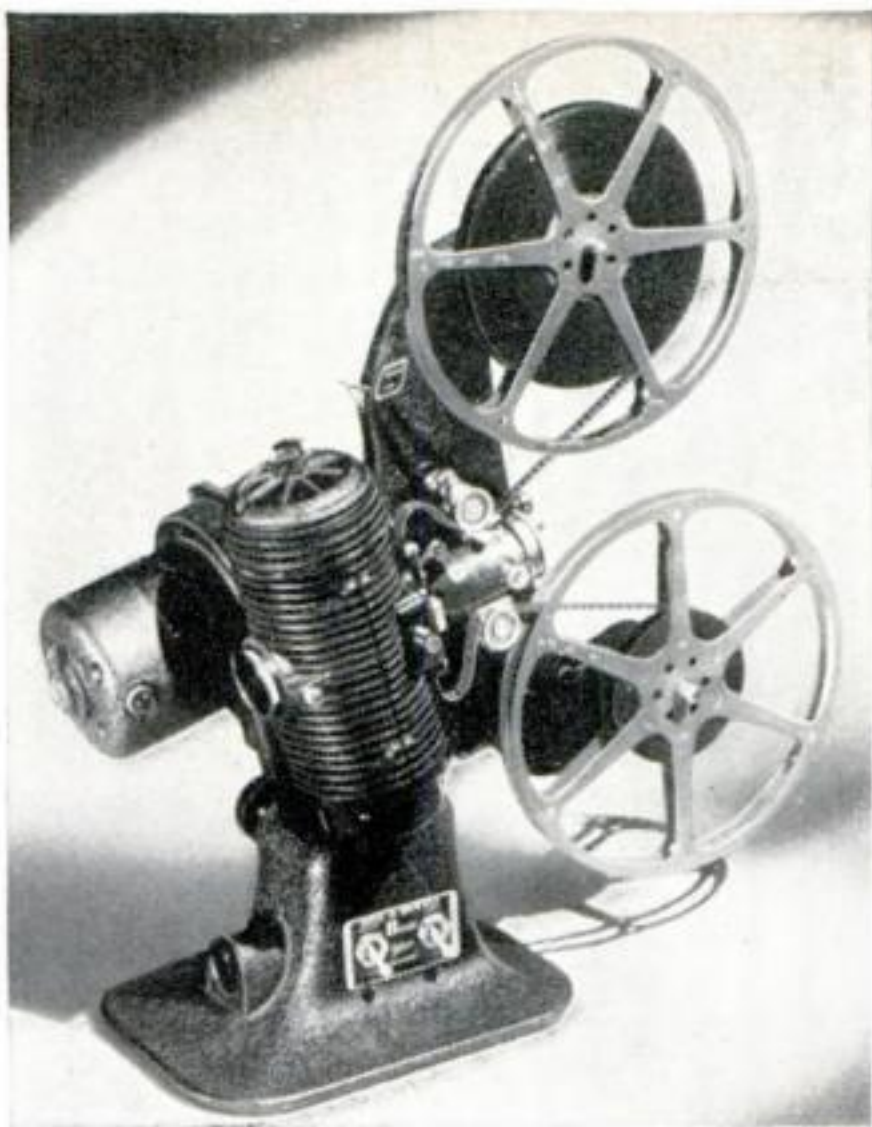
A number of other photographs among the hundreds submitted were of excellent quality. The judges gave special commendation to Myron Bernstein, of Brooklyn,

N. Y., for a portrait of a colored chef, and honorable mention to Don H. Gossling, of Berwyn, Ill., and Ralph W. Marks, of Chicago, Ill.

The winning picture was taken with a Rolleicord II camera, f/4.5 at 1/300 sec., on Eastman Panatomic film, developed in DK-20, and printed on Agfa Cykora No. 2 silk white paper.

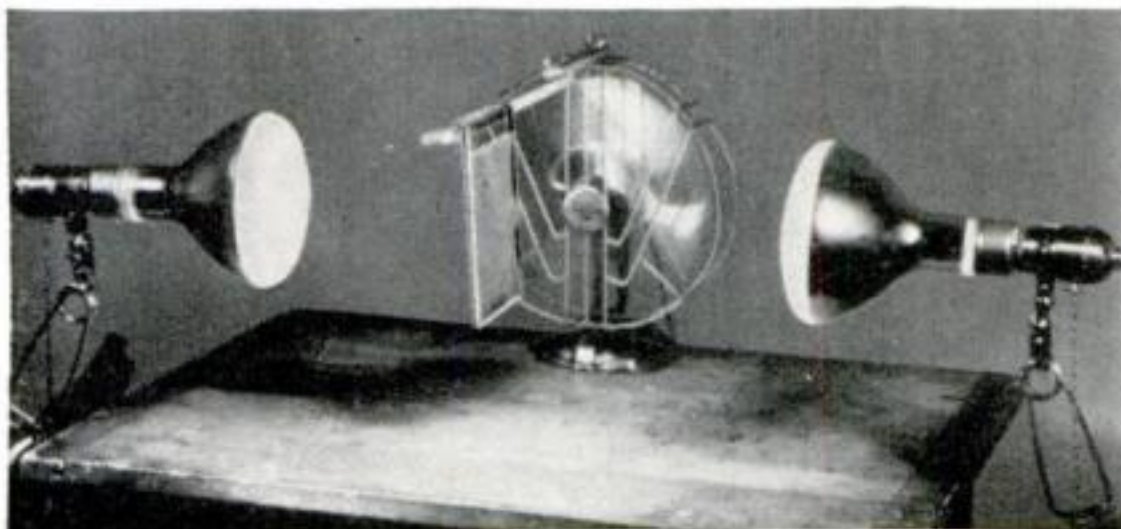
"I used the extra fast speed," Mr. Ehlke explained, "to keep the fur in the cap from blurring, as the wind was quite brisk. The portrait was taken on one of those hazy days. The sun was out, but it had to come through the thin layer of clouds and perhaps some high smoke from distant fires. Under similar conditions I have taken most of my portraits with pleasing results. Nevertheless, many persons are under the impression that a portrait requires a studio or unlimited lighting equipment."





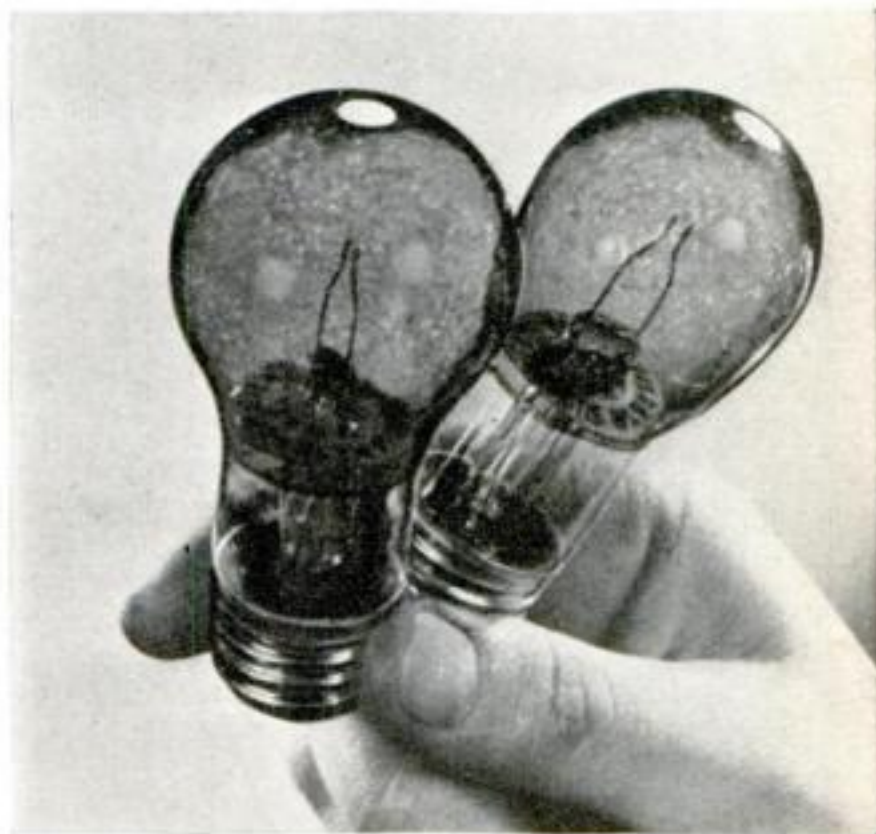
**PROJECTOR FOR 8-MM. MOVIES.** Taking reels up to a capacity of 400' of film, this 8-mm. projector has a number of other advantageous features to offer in the showing of home movies. Among these are an all-gear drive, prealigned and prefocused projection lamp, "floating film," fast lens, power rewind, metered lubrication, and two-way tilt. Because of the large capacity of the reels the machine will accommodate, a full half hour of screen entertainment with 8-mm. movies may be presented without interruption. A 400' 8-mm. reel of spring steel, designed especially for use with this projector, has also been made available in camera supply shops. A humidifier can of aluminum accompanies the new reel.

**INFRA-RED LAMPS DRY NEGATIVES.** Electric lamps that transmit heat by the radiation of infra-red rays and have their own built-in reflectors are now available for drying negatives. The radiations are said to pene-



## FOR CAMERA USERS

**COLOR-CORRECTED FLASH BULBS** now come in two small sizes for use in color photography and are suitable for all types of cameras, including focal-plane. Self-filtering blue jackets eliminate the need for separate filters when shooting indoors or outdoors with daylight-type color film or daylight-corrected one-shot color cameras.



trate through to the base of the film and start the drying process from within. The wet negative is suspended between two heat lamps placed about 2' apart, and an electric fan is placed behind the negative to send a flow of air across it as shown. With this set-up, the film will be bone-dry in from 1½ to 2 minutes. The lamps may also be used for drying photographic prints. Besides the sealed-silver type of lamp, two kinds of clear lamps are made for use with standard reflectors. The filaments operate at lower temperatures than those of illuminating lamps, and last for about 6,000 hours.



By **ANDREW R. BOONE**

**A**MATEUR movie makers are rapidly awakening to the possibilities of using sound with their pictures. Some of them already have sound-effect libraries and equipment with which synchronized narration or dialogue may be presented—such as the portable twin-turntable phonograph unit for which the complete constructional details appear on pages 194-197 of this issue.

One movie maker who has developed this picture-and-sound idea to the uttermost is Ray Fosholdt, of Long Beach, Calif. Friends visiting the rumpus room in his new home hear a voice from the ceiling say, "Settle down, folks, and I'll show you my newest movie."

Fosholdt, who has whispered the words into a hand microphone, then steps into the adjoining projection booth and starts his 16-mm. projector and synchronized turn-

table. In a few seconds his guests are enjoying both picture and dialogue.

Fosholdt designed the two-story house around his hobby. The projection booth overlooks an 11' by 22' recreation room on the second floor. Both the booth and the room are soundproofed, and were wired for microphones and speakers when the house was built.

A rheostat control in the booth dims the room lights, and after starting the projector and turntable, Fosholdt can return to his guests. Through a crystal microphone on a stand, they may offer comments as the scenes flash on the screen, or accompany the picture with dialogue or narration. As many as four persons, speaking into two microphones, may record dialogue for a picture while viewing it from a davenport. This method prevents sounds from the projector from being recorded—as would be likely to happen if recording were attempted from within the booth.

## MOVIE MAKER BUILDS



The screen speaker is hidden in a dummy lighting fixture. Through another speaker (on floor in photo at the left) the host or his guests can interpolate comment or narrative

Far from being merely incidental, the generous-sized projection screen above the table is a permanent fixture, framed between red draperies





Several persons can record dialogue to match lip action. One of the projection windows above them is visible behind the projector in photo at right, where Fosholdt is adjusting the recording turntable

## HOME AROUND HIS HOBBY

Fosholdt and his wife often add both dialogue and narration to their pictures. Dialogue is synchronized through the crystal mike with the lip movements of persons appearing in close-ups, while Fosholdt records narration through the hand mike. The sound for a 400' long 16-mm. picture is thus recorded on a single 15-minute wax disk.

To achieve a three-dimensional sound effect when showing a picture, Fosholdt often gives a running account of the scenes, his voice being heard through a dynamic speaker placed on the floor behind the audience. Recorded dialogue is heard through a ceiling speaker near the screen.

Tonal qualities and sound volume are adjusted from the booth, in which Fosholdt listens to a monitor speaker. Through the speaker system, he can converse easily with persons in the room, and this facilitates both cutting and recording.

While designing the projection room, Fosholdt did not forget his workshop. On the street floor he built an inner darkroom for processing film, and an outer laboratory where he mixes chemicals and photographs titles.

Within two hours after shooting a scene, he can process and dry the film, and show the results. The darkroom is constructed without windows, but has a ventilator in the ceiling. The cement floor slopes out-



Mrs. Fosholdt becomes a subject for a home-movie scene as her husband and a friend turn the camera upon her. Five flood lamps are being used for illumination. Two of these, in metal reflectors, are supported by adjustable arms from the tripod head





In his darkroom, Fosholdt can process film within two hours. After development, it is wound on this rack and transferred to a drying cabinet

Below, a "flopover" title is being shot on a special titling board. A chart on the base indicates size of field at various camera distances



ward, so that it can be conveniently washed with a hose.

When ready to develop film, Fosholdt winds a 120' negative on a drum of his own design. A motor-driven shaft revolves the drum as he moves a color film along from tray to tray for first developing, bleaching, clearing, redeveloping, fixing, and the several washings between and after these processes. A  $\frac{1}{4}$ -h.p. washing-machine motor furnishes the power, and through gearing from an old phonograph motor turns a countershaft at 10 r.p.m. The shaft extends the full length of five trays, the drum being driven from it by means of pulleys. Finally, the film is wound on a collapsible drying rack and placed in the adjacent drying cabinet, through which warm air is constantly circulated.

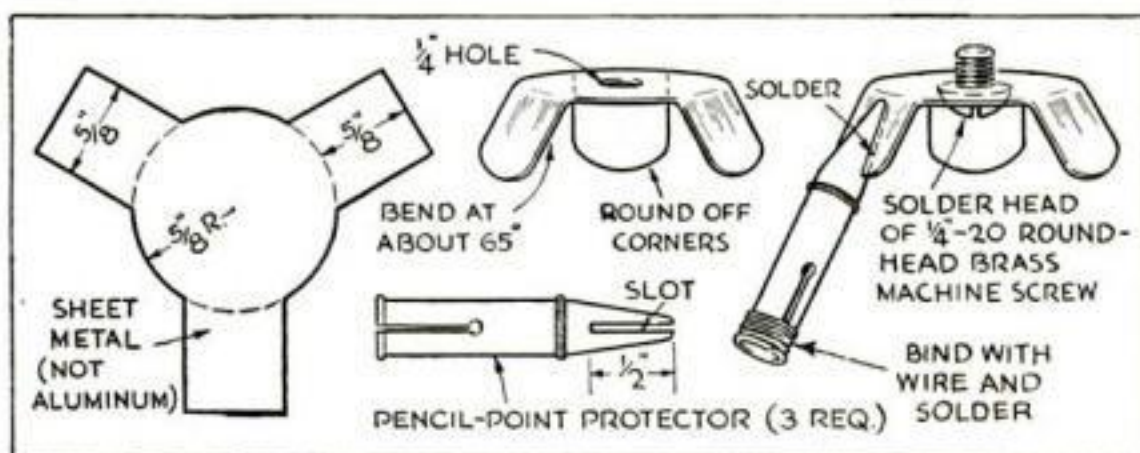
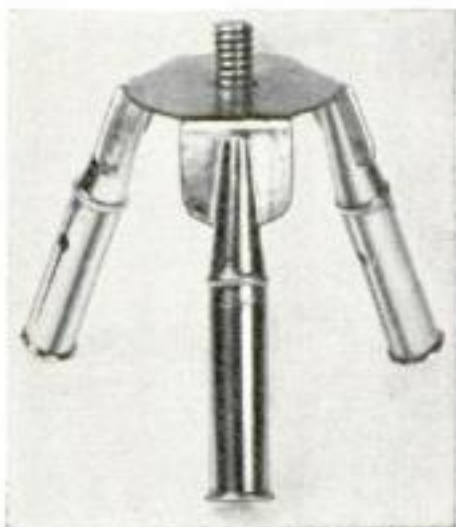
With his titling apparatus, which combines commercial units and some refinements of his own, Fosholdt turns out scroll, swing, roll-up, and standard presentations. The scroll and swing title holders are operated by a tiny electric motor. A blueprint, glued to the base of the titler, shows the areas of the field covered by the camera at all distances from 1" to 48".

Fosholdt processes both black-and-white and colored film in this compact plant. On overhead racks in the projection booth are stacked forty-two reels, each containing 400' of film. Much of his spare time is spent in the laboratory and at his projector entertaining himself and his friends, of whom twenty-two may be seated with comfort in the little theater.



## Three Pencils Serve as Legs for Table-Top Tripod

THREE pencils, a 3" square of 22-gauge brass or tin, three pencil protectors, and a  $\frac{1}{4}$ "-20 roundhead brass machine screw can be converted quickly into a table-top tripod with the aid of solder, tin snips, and a hack saw. Used with a tilting or swivel head, this will add to the versatility of a miniature camera. The erasers on the pencils will prevent slipping. Reinforce split ends of the protectors with wire and solder.—A. TRAUFFER.



A miniature camera set up on the "pencilpod," and a close-up of the tripod head. Three rubber-tipped pencils are inserted in the sockets to provide the legs

Left, details of the head. The  $\frac{1}{4}$ "-20 machine screw should be  $\frac{1}{4}$ " or  $\frac{5}{16}$ " long. It will fit any standard American tripod socket

## Extension Cord Kept Coiled on Back of Reflector

Small angle brackets, bolted or riveted as shown below to the back of a photo-lamp reflector, convert it into a convenient rack for winding up an extension cord. The brackets employed are of the type commonly used for radio work, and two will be found large enough to hold more than the usual 20' length of wire.—KENNETH MURRAY.



## Negative Rack for Darkroom

NEGATIVES will not get mixed or become damaged on the darkroom worktable if they are kept in a wall file of the type shown. It has labeled pockets in which they can be placed for enlarging, contact printing, reducing, or intensifying. After the necessary work is done, negatives are returned to a pocket marked "file." Below is space for charts and leaflets.—CHARLES BROWNOLD.



# Blackout Photos

TAKEN WITH  
INFRA-RED FLASH



Pictures in the dark are fascinating fun. This couple did not realize that a strolling photographer had snapped them by using a "blackout" flash-bulb unit with infra-red film

A gelatin filter converts a safelight into a dark-flash unit. Shots can be made with or without synchronization

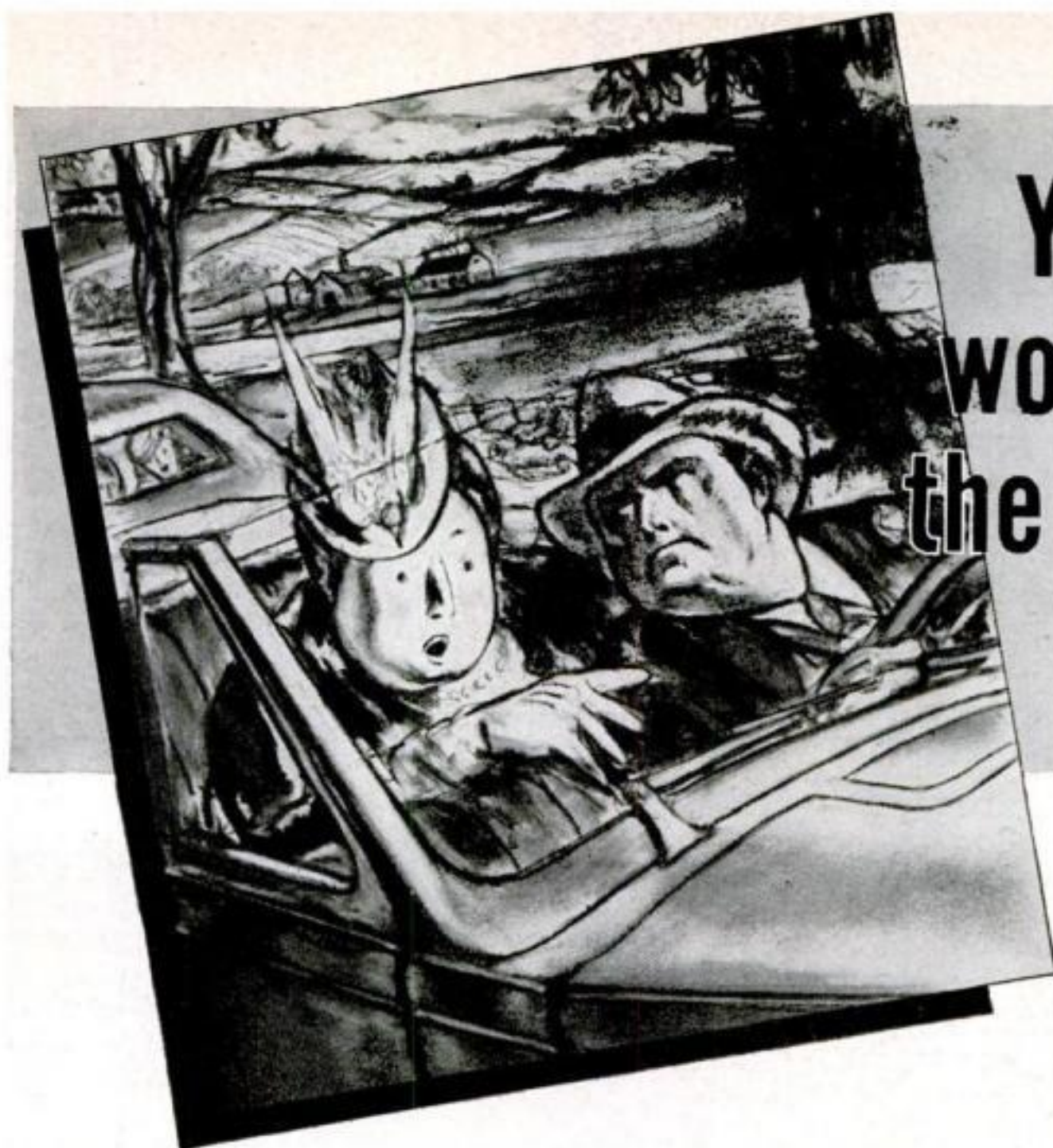


The sleeper was not disturbed by the invisible flash that made this photo. A "sun-tan" make-up will improve the rendering of flesh tones

SO-CALLED "blackout" photos such as have been taken in London can be made by any photographer with simple equipment. Infra-red film is used with a "black light" photoflash lamp. This is a small dark-room safelight fitted with a flash bulb and an infra-red filter (Wratten No. 87 or equivalent). Using a No. 21 bulb not farther than eight feet from the subject, a synchronized exposure of 1/50 second at f/4.5 gets the picture.

If you have no synchronizer, open the shutter on "bulb," set off the invisible flash, and close the shutter. To photograph large areas, leave the shutter open while you walk about the scene setting bulbs off in a hand gun.





You may  
worry about  
the back-seat  
driver

but here is one worry you can avoid

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ORIGINAL PARTS ASSURE "LIKE-NEW" PERFORMANCE

## Gus Checks Up on Ignition

*(Continued from page 136)*

Good. But what if you didn't have a lug?"

"I—I dunno," Johnny admitted. "Say, Mr. Wilson, I got something to tell you. I—"

"Let's stick to what we're doing," Gus interrupted. "If you haven't got a lug, you should dip the end of the wire in solder before you make the loop. That'll do in a pinch. Well, the primary-circuit wiring is all right. Now we'll check the plugs. Switch on the ignition, and start her when I say."

He held a screw driver so that it rested on both the engine block and on the wire connection on top of a spark plug. "Step on her," he told Johnny. With the engine running he checked each plug in the same way. "Switch her off," he said finally. "The plugs are all O.K. If any of them had been bad we wouldn't have noticed any 'miss' as we checked each one."

He removed the plug cables from the distributor. "All the terminal clips are tight, as they should be," he said. "The sockets in the distributor cap should be clean and free from corrosion. Here's one that isn't—pick the corrosion out with the pointed end of a small round file . . . That's good. Now put the cables carefully back in their sockets."

Once more, Gus took off the distributor cap. "Now, Johnny, you turn the engine over," he said. Gus watched until he saw the breaker points come together. "Stop! Switch the ignition on." He broke the contact-point connection with the tip of a screw driver. There was a slight spark and the ammeter hand fluctuated. "The distributor is O.K.," he decided. "If we didn't get a spark, or if the ammeter hand didn't move, it would mean that there was an open somewhere between the battery and the primary circuit—probably a bad switch or cable."

Gus examined the contact points carefully. "They're not burned or pitted," he said. "The spacing of the points is correct. The cam is all right. There's no crack in the distributor cap which might allow high-tension current to leak, and so cause mis-firing. That about winds things up."

"Say, Mr. Wilson, I got to tell you something!" Johnny insisted. "I joined the Air Corps this noon. I'm quitting tonight!"

Gus's lower jaw drooped and his face got red. "Then—then why the devil did you let me waste an hour giving you a course in ignition trouble-shooting?" he demanded.

"I tried to tell you," Johnny said defensively. "Twice. But you wouldn't let me."

Gus grinned. "You're right—you did try. Well, go and tell Mr. Clark, so he can get your pay ready. And lots of luck, Johnny!"





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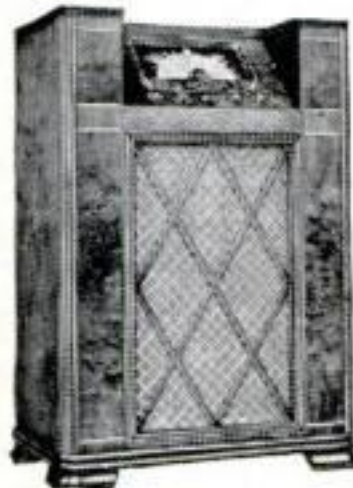


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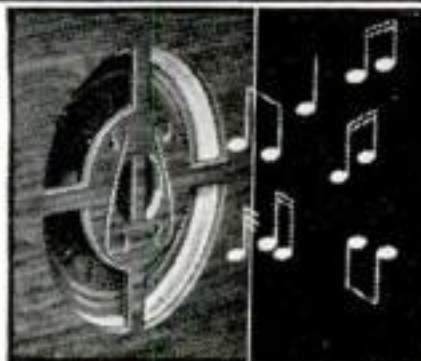
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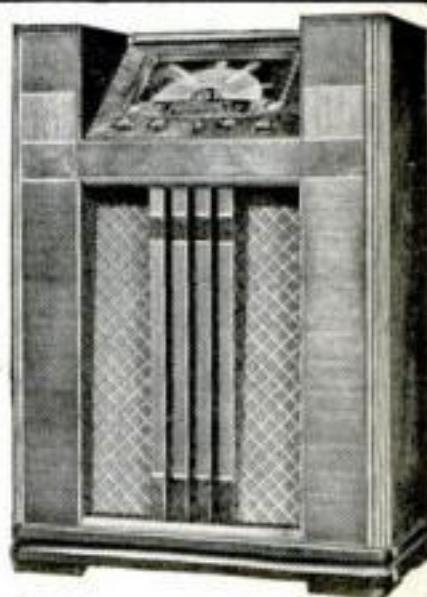
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Enjoy fascinating entertainment with a Midwest automatic record-playing 8, 11 or 16-tube radio-phonograph. Talk or sing into the studio-type microphone or make a record of your family's voices. Enjoy a full hour of entertainment because up to twelve 10-inch or eleven 12-inch records may be played automatically. Buy your radio the Midwest Home-Trial way! Test it in your home for 30 days before you make up your mind! Write today for big, FREE catalog, featuring many beautiful 1942 factory-to-you radio chassis and console values — from 5 to 16 tubes — including Automatic Record-Changing Radio-Phonographs, Home-Recorder, etc. — from \$11.95 to \$212.50.

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• *United Air Lines' Chief Mechanic at La Guardia Airport, Peter Berger, smoothing the leading edge of a hydromatic propeller with a Nicholson File. Pete, who has been an aircraft mechanic since 'way back in 1917, has depended on Nicholson Files for all the fine work that must be done around airplane engines and propellers.*



## The Man with the File ↙

• We as a nation are busy today. We are building as we have never built, in the hope that we can keep the sound of an enemy airplane from sending us scurrying to the cellar.

We often think of this defense effort in terms of great machines and humming motors. But machines can't do everything . . . there is a place for skilled hands all along the line. The man who can handle a file well, for instance, often takes up the job where machines leave off.

And—if he keeps himself abreast of the constant Nicholson developments in files for meeting new demands in every industry, he's that much ahead of "the other fellow" when there's a choice job open or a promotion in order. (For example, Nicholson makes aluminum files and rasps of special design for the aircraft industry.)

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## Civilian Defense

*(Continued from page 48)*

are allowed to know who these workers are.

Men who were members of Maplewood's volunteer fire companies in the days before the town had a paid fire department rallied to the cause and formed a reserve fire-fighting unit. Doctors and nurses volunteered to help out with the first-aid and medical work if they were needed. District wardens —300 of them—who will be trained as air-raid wardens and also will serve as general liaison workers to see that everybody in the community is kept up to date on defense plans, were recruited from a town committee that had been organized previously for a different purpose and had a representative for every block in Maplewood. By using existing organizations in some cases, it was possible to cash in on the previous experience of the members in working together.

There's room for all kinds of willing workers in such a set-up, and you'll find all kinds represented in the Maplewood organization. John B. Drake, who operates a bakery, is in the intelligence division. His 12-year-old son, incidentally, is a railroad enthusiast, and his admirers say the lad can tell you the time each and every train is due at Maplewood. Edward Harboulas, maintenance man for the Board of Education, is another intelligence worker.

Alan R. Kemp, who works for a New York bank, is a lieutenant in the police reserve unit, and his wife is a volunteer ambulance worker with the family station wagon. Chief of Police Gustav Swann heads the council's subcommittee on public safety.

Maybe your own community is already hard at work on a program similar to Maplewood's; maybe it hasn't yet pushed its home defense set-up much beyond the planning stage. But judging from the way things are going in most parts of the nation, there's no lack of volunteer workers. Everybody seems to agree that it's a good idea to plan for the worst even while hoping for the best.

### Question Bee Answers

Here are the correct answers to the Question Bee on page 120. Check your own results with this list and give yourself ten points for each one you had right. A total score of 70 is good.

- |      |      |      |      |       |
|------|------|------|------|-------|
| 1. b | 2. b | 3. c | 4. a | 5. b  |
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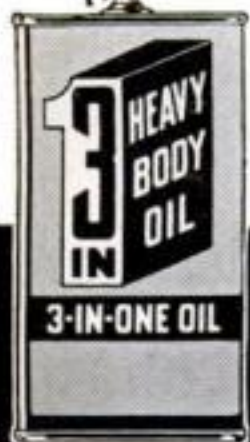
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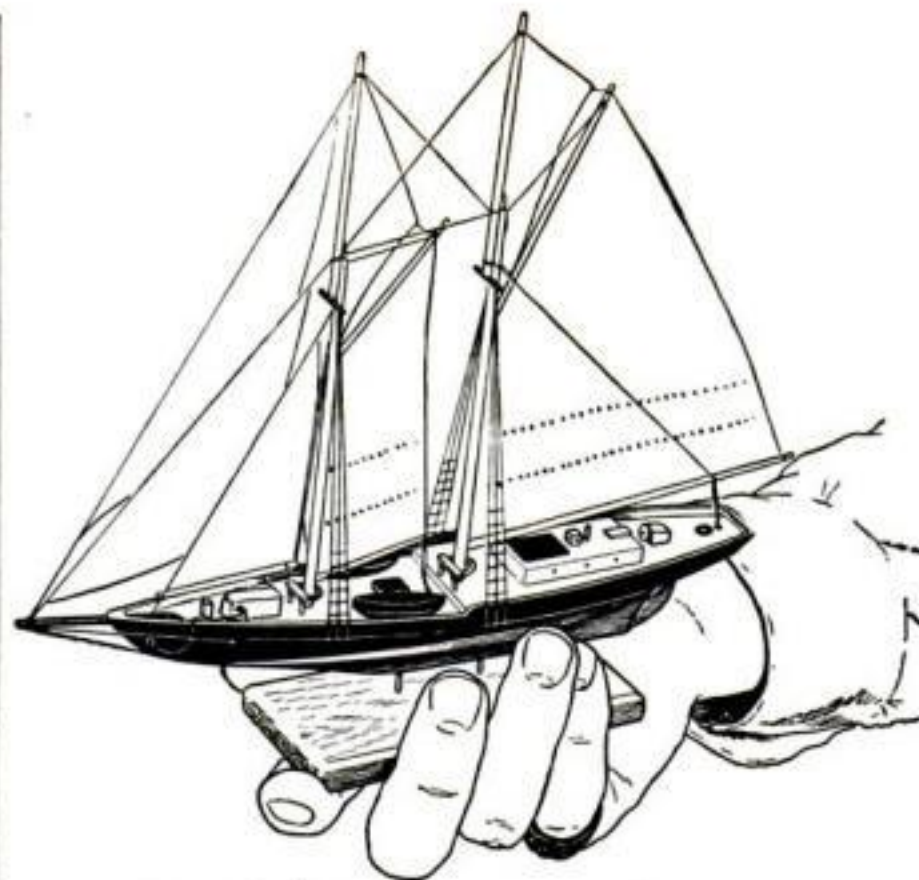
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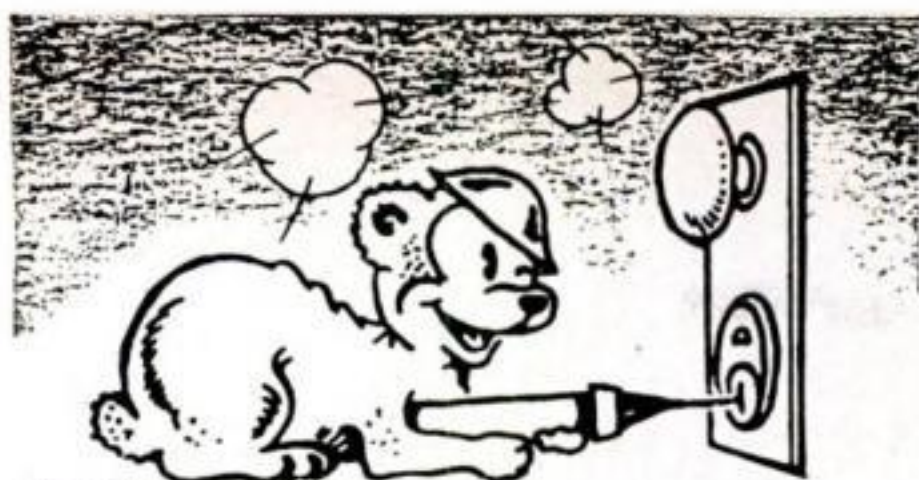
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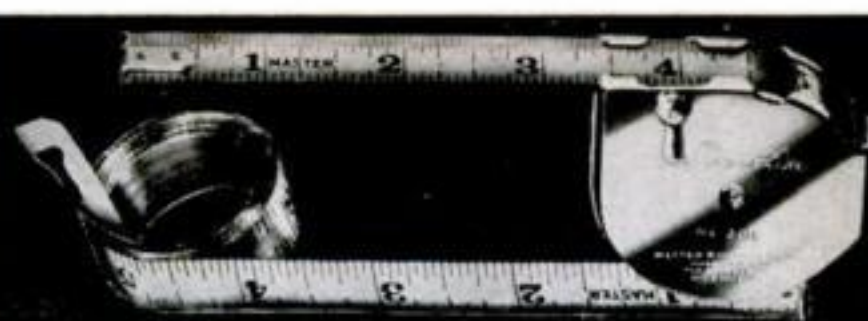
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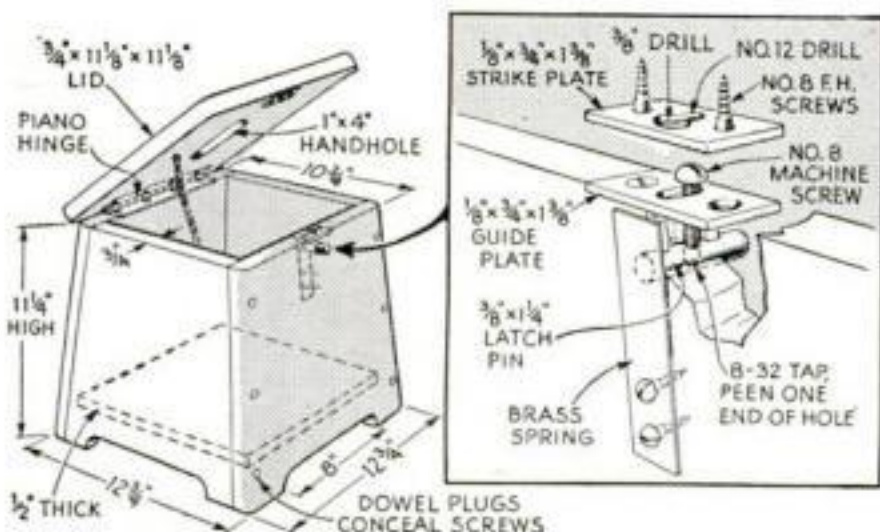


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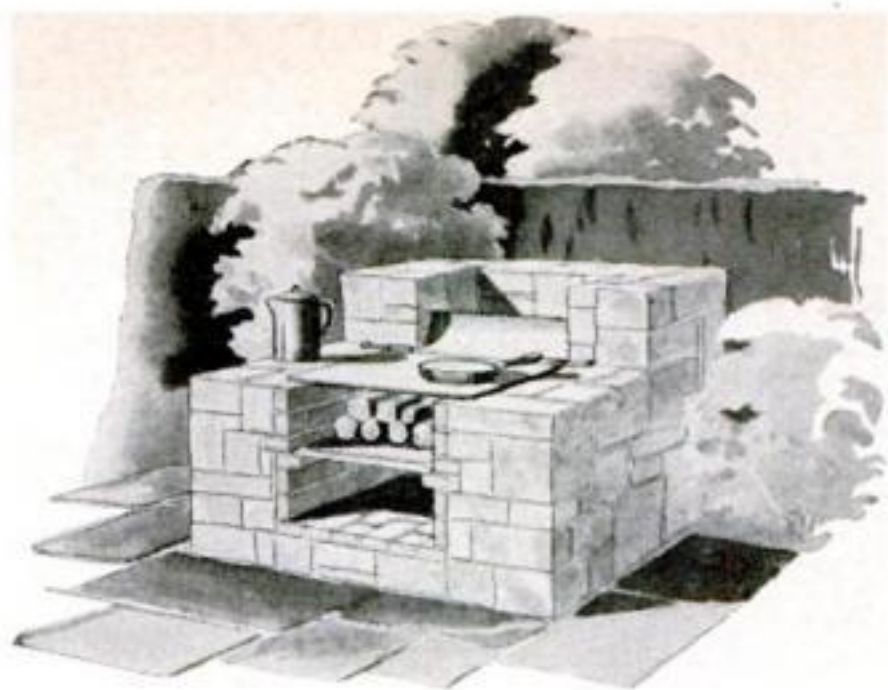
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(Continued on page 221)

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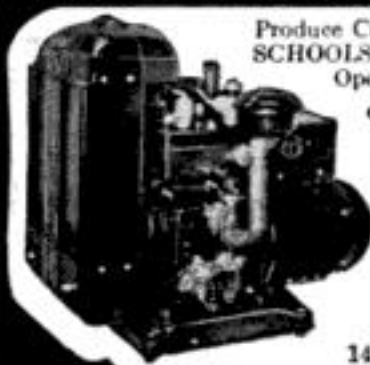
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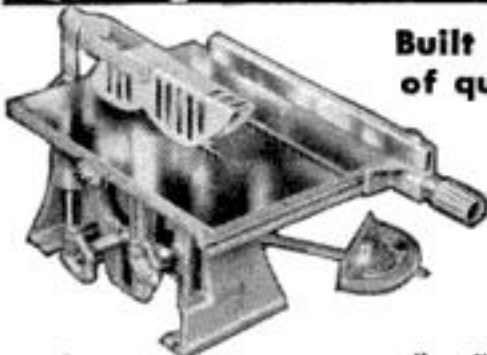
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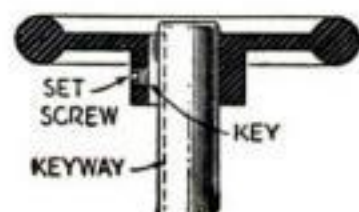
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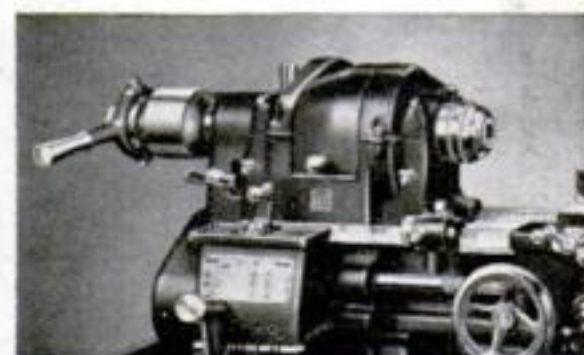
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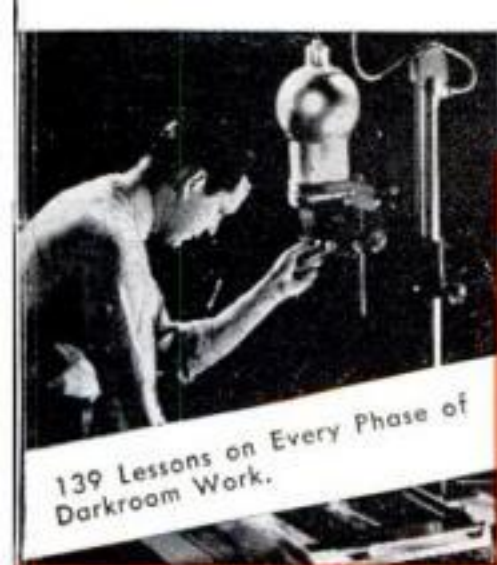
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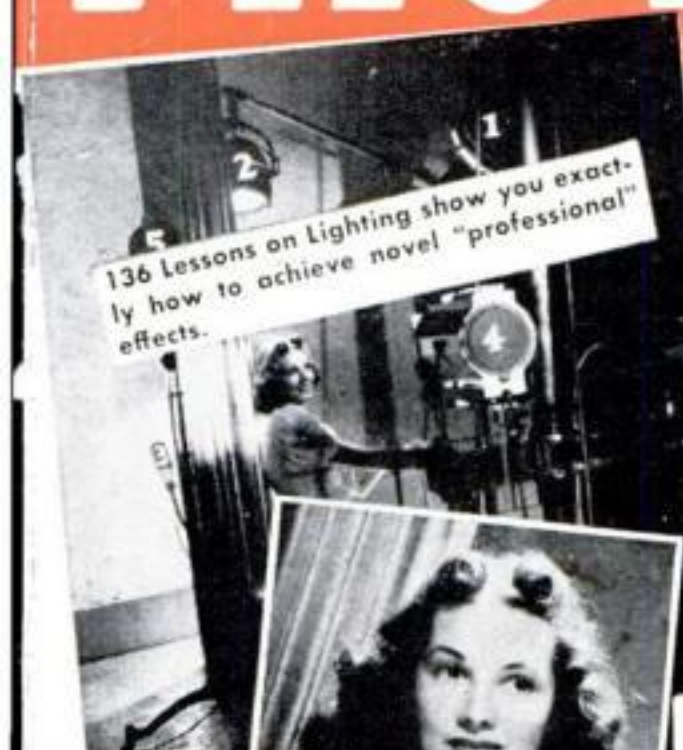
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THEY CALL HER “LIGHTNING.” Pilot Headle clambers into the cockpit, switches from a pocket oxygen flask to his cabin supply, and streaks for the stratosphere. He’s test-flown 300 different planes. But when he lands, it’s always . . . “Now for a Camel.”



YOU CAN’T SEE HIM up there. You can scarcely hear the hum of his motors. Then his voice comes into the radio tower: “Headle—35,000 feet—diving now.” Seconds later—yes, seconds—he’s landing. And here he is (*above*) cool, calm, lighting up a Camel.



## THE SMOKE’S THE THING!



CAMEL’S  
**EXTRA MILDNESS**  
IS PLENTY OKAY WITH ME.  
I SURE GO FOR  
THAT FULL, RICH  
**FLAVOR**

The *smoke* of slower-burning  
Camels contains

# 28% LESS NICOTINE

than the average of the 4 other  
largest-selling brands tested  
—less than any of them—  
according to independent  
scientific tests *of the smoke itself*

*“Less nicotine in the smoke means  
more mildness to me,” says test pilot  
Marshall Headle, as he lights up  
America’s favorite cigarette*

THERE may be little traffic at 35,000 feet, but test-diving any new plane is no Sunday joy-ride. No, not even for veteran Marshall Headle (*above*).

Naturally, cigarette mildness is important to Marshall Headle. And in the cigarette of costlier tobaccos . . . Camels . . . he gets extra mildness — with less nicotine in the smoke. Try Camels. For convenience—economy—buy the carton.



BY BURNING 25%  
SLOWER than the average of the 4 other largest-selling brands tested—  
—slower than any of them—  
—Camels also give you  
a smoking *plus* equal,  
on the average, to

**5 EXTRA  
SMOKES  
PER PACK!**

R. J. Reynolds Tobacco Company  
Winston-Salem, North Carolina

# CAMEL THE CIGARETTE OF COSTLIER TOBACCOS